REGIONAL ASSESSMENT OF COASTAL GEORGIA

The region has an opportunity to shape the scope and character of future development, identify existing and emerging needs and update the Regional Plan to assure that top issues are addressed and communities are able to continuously revitalize.

Coastal Regional Commission

Coastal Regional Commission

The Coastal Regional Commission (CRC) is the regional planning and intergovernmental coordination agency created by local governments in the region pursuant to legislation passed by the Georgia General Assembly. The CRC has authority under state law as a Regional Commission (RC), effective July 2009, as outlined by House Bill 1216 in 2008.

The CRC is the forum through which local governments in the region meet to solve mutual problems and decide issues of region-wide importance. Additionally, the CRC collaborates in programs of research and study, and engages in planning that affects the coastal region.

The CRC works closely with the region's counties and cities to address a wide range of issues, including infrastructure, resources, economic development, historic preservation, growth management, and the delivery of services to older adults, persons with disabilities, and their family caregivers. Over the course of decades, the CRC has maintained a strong working relationship with the members it serves and has achieved national recognition for its ability to develop and promote efforts that impact the region as a whole.

Regional Assessment Partners

The CRC works closely with higher education institutions as these institutions are aligned with and dedicated to the livability and economic vitality of the 10-county coastal region.

Leaders from regional partnerships include:

John F. Crowley III, PhD; J. Marshall Shepherd, PhD.; Stephen Ramos, Ph.D.; Rosanna Rivero, Ph.D;, and Ron Thomas, FAICP each from the College of Environment + Design, UGA;

Lissa Leege, Ph.D. from the Director Center for Sustainability Georgia Southern University;

Dr. Lambright from Savannah State University; and Michael W. Burns, Senior Advisor to Regional Administrator, EPA Region 4.

College of Environment + Design, UGA

In July 2013, the CRC created a formal partnership with University of Georgia. This partnership assessed how well existing planning tools address hazard risk and community resiliency with the goal of integrating resiliency guidelines and performance standards into the Update of the Regional Plan.

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Center for Sustainability, Georgia Southern University (GSU) + EPA Region 4

The mission of the Center for Sustainability at Georgia Southern is to 1) increase education and awareness of sustainability issues, both on campus and in the community; 2) provide incentives for faculty, staff, and students to incorporate sustainability in research, teaching and service; 3) form partnerships with local community to improve sustainability; 4) implement best practices in sustainability. The Center is directed by Lissa M. Leege, PhD, Professor of Biology & Director, Center for Sustainability, Georgia Southern University, Statesboro, GA.

2015 GSU

Students Hans McIntosh, student, GSU worked on logistics data with Don Masisak and David Dantzler, CRC.

Elli Chapman, student GSU worked with Jenifer, Hilburn, Altamaha Riverkeeper and Hunter Key, CRC GIS in collecting and mapping data.

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Introduction

Georgia is home to one of the most pristine and undeveloped coastlines in the eastern seaboard. This eastern shore stretches almost 100 miles from Savannah at its northern point to St. Marys at its southern tip. It's here one finds abundant wildlife, beautiful beaches and over 2300 miles of tributaries and salt marsh.

Equally important, one finds historic towns, industries, major ports, and a thriving tourism trade, each driving some part of the region's economic engine. Positive growth is important in maintaining coastal Georgia as unique area of the state. Together, coastal leaders are meeting the challenges of how to encourage and plan for quality economic growth while protecting the integrity of the coastal region's natural resources.

Regional Assessment Purpose

The purpose of the Regional Assessment is to present a factual and conceptual foundation upon which the rest of the regional plan is built. Preparation of the Regional Assessment is largely a staff or professional function of collecting and analyzing data and information about the region and presenting the results in a concise, easily understood format for consideration by the public and decision-makers involved in subsequent development of the Regional Agenda.

The Regional Assessment is the first part of the regional plan initiative. It is an objective and professional assessment of data and information about the region intended to be prepared without extensive direct stakeholder involvement.

The Regional Assessment includes: (1) **a list of potential issues and opportunities** the region may wish to take action to address;(2) analysis of projected regional development patterns, including **a map of desired future development patterns for the region**; (3) **evaluation of current policies, activities, and development patterns** in the region for consistency with the Quality Community Objectives; and (4) **analysis of data and information** to check the validity of the above evaluations and the potential issues and opportunities.

The product of the Regional Assessment must be a concise and informative report for decision-making by stakeholders during development of the Regional Agenda portion of

the plan. The Regional Assessment identifies and confirms the region's needs. In addition to meeting the requirements of the regional assessment for the Georgia Department of Community Affairs (DCA), the **Assessment also identifies critical findings that lay the groundwork for policy and program development** during the regional development planning process.

Regional Assessment

Since the first Regional Plan of Coastal Georgia was adopted in 2010, and updated to include the Regionally Important Resource Plan in 2012, Coastal Georgians continuously worked to create a region that is culturally vibrant, intellectually curious, innovative and beautiful. Coastal Georgia linked land use, transportation, economic development, green spaces and people, and poured effort and resources into developing regional leaders.

How do we develop the region, compete as a region, attract talent and ensure high-paying employment and maintain our regional identity?

We cleaned rivers, promoted new ways of managing stormwater and became a major player as the eastern seaboard's growing port and distribution hub. Since the adoption of the Plan, Coastal Georgia has shown it can grow a vital economy, protect the natural environment and support vibrant places to live and work.

Today, despite these many successes, education, jobs, housing, and workforce development need attention, and there are major challenges on the horizon. As we update the Regional Plan we ask, "How do we develop the region, compete as a region, attract talent and ensure high-paying employment, and maintain our regional identity?"

To effectively tackle these challenges, we set a focused, strategic path forward – a path based on a clear understanding of conditions and trends, challenges and strengths.

Methodology

In July 2013, the CRC created a partnership with the College of Environment + Design from the University of Georgia. This partnership's first task was to **assess how well existing planning tools addressed hazard risk and community resiliency.** Students from the

Environment and Design Studio were on site to collect data, establish contacts and present initial findings at the American Planning Association (APA) GA Chapter State Conference on Jekyll Island. A **Hazard and Resilience Assessment for the Coast of Georgia, February 2014** was completed and promulgated to propose Resilient Communities as a topic of importance in the Update of the Regional Plan. See Appendix A.

With continuing efforts to create *Resilient Communities* as a topic of regional importance, in **December 2014, the objective of defining how urban form impacts climate and how design could aid the process of adaptation was addressed and defended** by Mariana Barreto Alfonso. The research assessed how climate factors combined with physical landscapes interact; what are the different climatic responses between the built environment and the natural landscape; what key climate factors have direct impact in climatic perception and effect comfort; and what design solutions can be examined that could improve the effects of the built environment on climate. The methodological approach took into account three different scales including the regional scale, city scale, and the site specific scale.

The major professor for the **Planning with Climate: Urban Design as a Tool for Adaption** was Rosanna G. Rivero. The Dean of the Graduate School was Maureen Grasso and Committee Members were John F. Crowley III, J. Marshall Shepherd, and Lupita McClenning of the CRC. See Appendix B.

In the spring of 2014, a **Sustainable Communities Plan for Coastal Georgia** was completed over a 15 week period for a five-county study area including Bryan, Camden, Glynn, Liberty and McIntosh Counties. This project assessed existing conditions, development types and patterns, and the natural environment; and explored issues and opportunities. See Appendix C.

In March 2015, the effort to assess the resiliency of communities continued with the creation of **Resiliency Matrix to Test the Resilience of Planning Documents for Coastal Georgia**. A matrix was created by Shruti Agrawal to be used **as a checklist to evaluate the performance of planning documents for managing the conditions generated by the impact of a natural event and to help in identifying missing portions of documents**

that need to be completed in the future. According to the multi-hazard mitigation plan status by FEMA, of the 11 states in the country with the FEMA approved enhanced state mitigation plan, Florida and North Carolina have mandated it for the coastal cities. Although Georgia has a statewide hazard mitigation element in the plan, it is not adopted by cites in their comprehensive plan. The **matrix too can easily be used for evaluation of the planning documents and be updated depending upon the type of natural event. The resiliency matrix tool can be used as a simple framework for evaluating the performance of planning documents.** The major professor was Umit Yilmaz, PhD., committee members include John (Jack) Crowley III, PhD., Rosanna Rivero, PhD., Pratt Cassity and Lupita McClenning, CRC Director of Planning. See Appendix D.

The CRC also utilized the Quality Growth Effectiveness (QGE) Assessment Survey as an Evaluation and Monitoring tool to measure performance standards as they relate to ongoing implementation of the Regional Plan. The QGE survey compiles *A State of the Region* through responses from local jurisdictions regarding consistency with the Regional Plan of Coastal Georgia. These answers determine the Plan's effectiveness, identifies implementation barriers, areas of best practices and most importantly areas of the Regional Plan that may require modification moving forward.

The CRC assessed the region and the current Regional Plan's effectiveness through local government feedback during formal *Plan Implementation Meetings*. Feedback is garnered during DRI consultation, CRC Leadership programs such as city and county retreats, CRC Practicums, GIS technical assistance and support, grant exploring opportunities, and through participation with the Georgia Initiative for Community Housing (GICH).

Feedback from key staff and elected officials during *Plan Implementation Meetings* recommend that for the Update of the Regional Plan that performance standards be created with a threshold specific to rural areas. Feedback during Plan Implementation Meetings also recommend that the Agriculture Land performance standards be revised to include points for local farmers market, and local businesses who utilize local seafood and farmers' markets.

Additionally, it was discussed that the Plan should identify meaningful performance standards by more carefully selecting clear goals that can improve smaller local governments approach to best practices.

What did We Discover?

Coastal Georgia has distinct issues based on 1) unique topographies, 2) natural features, and 3) varying demographics. The region is geographically large, covering 5,863 square miles (15,185 square km); and consisting of ten counties including urban, suburban, and rural areas, 35 municipalities of varying population, and large areas of very low population density. Planning is essential for any region with a wide variety of development patterns in order to ensure that rural, suburban, and urban areas have equitable access to infrastructure and services. In addition, planning is important for any region with a large number of jurisdictions in order to encourage cooperation and collaboration.

List of Potential Issues and Opportunities

The issues facing the region continue to change and evolve, becoming more and more complex. In addition to the traditional issues related to housing, transportation, land use, and economic development, a series of new concerns have emerged. These include, but are not limited to, energy production and consumption, climate change, lifecycle costs of public investments, and community health.

Considering the impact of comprehensive planning, including the new generation of sustainability plans, on social, economic, and environmental conditions, there is a need to explore the ways in which jurisdictions include public health goals and objectives as part of the comprehensive planning process. Identifying local planning responses to important health issues and examining how comprehensive and sustainability plans can promote long-term community health can help planning staff and practitioners better understand the role of health in planning and help to identify tools and strategies for integrating public health-related goals and policies into the plan-making process.

Issues for adaptation include the need for information and data as a basis for understanding potential risks and vulnerabilities, meaningful and effective stakeholder engagement shaped by local contexts, and sustained financial and staff resources that are

sensitive to urban variability. Policy-makers working on issues of adaptation and resilience must facilitate processes of testing ideas, learning from experiences, and recalibrating as new information is obtained and lessons are learned.

Development of Key Theme

The **Evaluation and Monitoring Report** reports on recent changes and recommends amendments to the Plan as data is collected, trends emerge and best practices are explored. The region has an opportunity to shape the scope and character of future development, identify existing and emerging needs and update the Regional Plan to assure that top issues are addressed and communities are able to continuously revitalize. By this definition, built environments become livable; ecosystems become healthier; economic development becomes more responsive; and the benefits of improved environmental and economic development become more equitably distributed among the region.

Regional Assessment Key Finding – Community Resiliency

Resilience is important in a changing world. Coastal Georgia faces major uncertainties including competition for resources and the impacts of coastal risks and vulnerabilities. While these issues affect the entire region, some communities are more vulnerable. In order to recover from potential setbacks, Coastal Georgia must become more resilient in a variety of ways and at a variety of levels. The regional coast of Georgia needs a well-designed and strong social, ecological, and economic infrastructure to adapt to its evolving future.

States, counties and municipalities must have an approved Hazard Mitigation Plan in order to apply for and/or receive hazard mitigation grant funding. There are notable differences found in Comprehensive Plans and Hazard Mitigation Plans. Hazard Mitigation Plans are often developed without active participation of local community development and/or planning staff. Strategies often include a focus on structural projects versus non-structural measures such as land use or policy alternatives. Hazards Mitigation Plans are generally stand-alone documents that don't link to other community based plans. Including

community resiliency in the Regional Plan of Coastal Georgia as a topic of regional importance can mitigate longer-term risks by promoting suitable development patterns.

For the purposes of this Assessment, the factors that define "resilience" are identified for the field of urban planning specifically for events like hurricane and tropical storms in the coastal cities of the South Atlantic Coastal Region.

For a planning document to support the resilience of different factors such as demographic, infrastructure, and ecology it is important to be aware of the issues that define these factors.

Environment + Design, UGA reviewed academic literature, several case studies and planning documents and identified different factors and issues for which resilience is discussed when considering urban planning. A matrix listing all those factors and their issues was created called the *Resiliency Matrix*. This matrix was used to test the performance of the local governments planning documents.

The results indicate two things: (1) the resilience scores of the city, and (2) the missing sections of the documents that can be updated for enhancing its performance for mitigating the impact of natural event in future.

Analysis of Regional Development Patterns

Regional Mapping

Projected Development Patterns

Projected Development Patterns Map The Regional Projected Development Pattern Map is created by incorporating the **Regionally Important Resources** map with each jurisdiction's map from their adopted local Comprehensive Plans and analyzed for current trends as it relates to developing, developed, and rural development patterns. The Regional Projected Development Patterns Map reflects the most recent trends and projected land use patterns from local Comprehensive Plans created or updated under DCA's Local Planning Requirements and the most recent comprehensive inventory of the Region's natural and cultural resources.

Regional Development Patterns include:

- **Conservation**: Primary conservation areas include, but are not limited to, wetlands, flood plains, streams, endangered species and critical habitat, prime agricultural lands, and federal or state listed species. Conservation areas include essential buffers along streams and wetlands, and water bodies that require riparian buffers.

  Identifying and preserving coastal Georgia's Green Infrastructure network supports biodiversity and functional ecosystems, protects native plant and animal species, lessens the disruption to natural landscapes, limits invasive species, which in turn will enhance and support water quality, provides for quality growth land use planning, support the implementation of stormwater management plans and regulations, encourages the creation of transportation corridors and connections, fosters ecotourism, tourism and outdoor recreation, enhances the business climate, and ensures a high quality of life for coastal residents.

Rural: Areas not expected to urbanize or require urban services.

Efforts to maintain the character of rural areas are encouraged to protect viewsheds by providing for tree buffers along roadways, endorsing landscaping and significant tree preservation plans, and regulating unsightly uses such as junk yards or outdoor storage of heavy equipment. Local governments should make a conscientious effort to

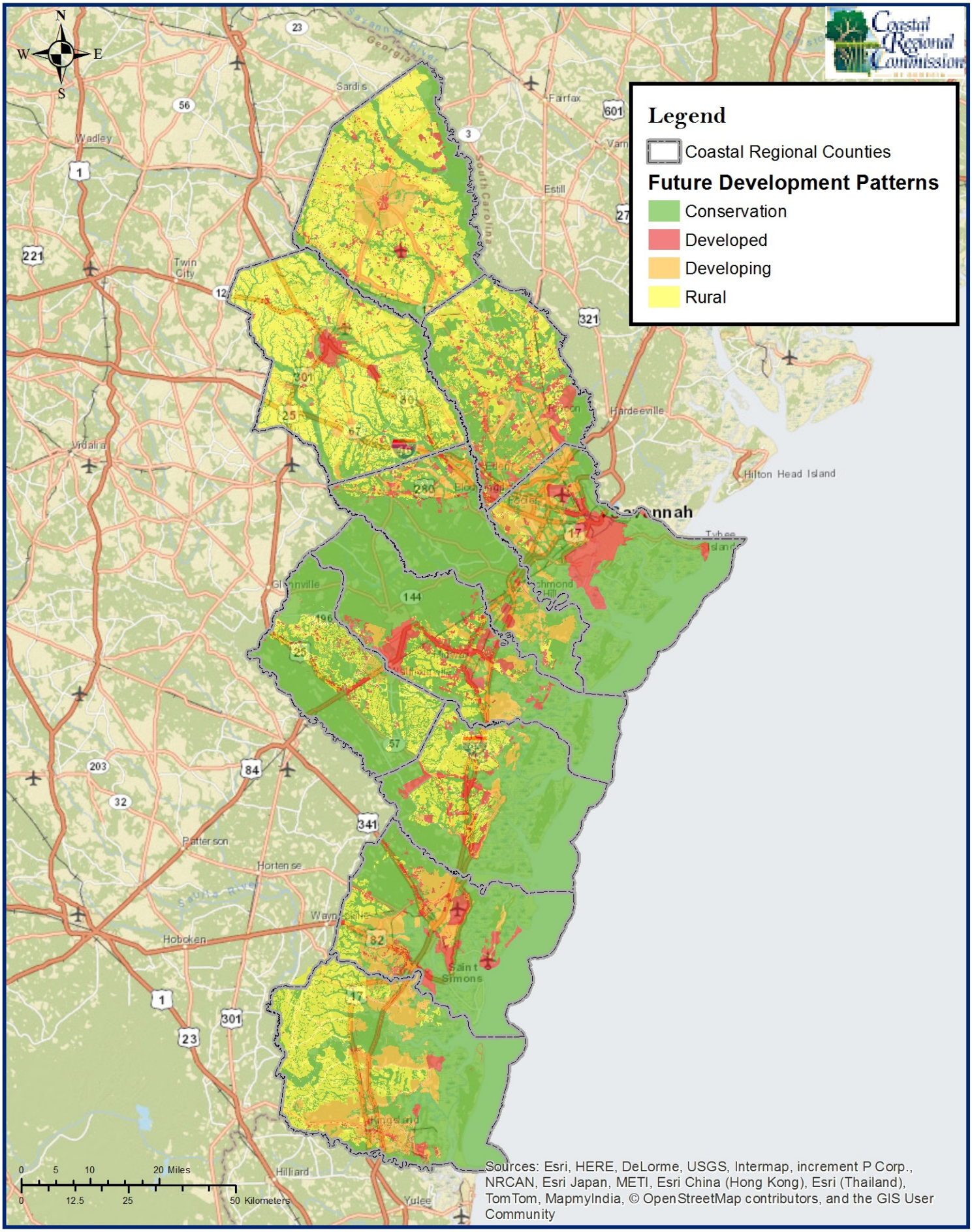
withstand pressure to provide water and sewer services to dispersed areas and discourage urban development from occurring in areas at substantial distances from existing urban areas, or leaping over undeveloped land suitable for development.

Developed: Areas demonstrating urban development patterns and also illustrate the areas where water and sewer services are being provided.

A coordinated land use and infrastructure planning policy encourages the concentration of new development in and around cities; promotes infill and redevelopment. Local governments should give top priority to repairing and reinvesting in existing infrastructure such as roads, water, sewer and utilities, by fixing and maintaining what exists. Funding for expansion, growth, and new purchases is limited and such a strategy helps communities avoid subsidizing sprawl. Exercising this approach promotes reinvestment in blighted areas and combats disappearing rural scenery. It also avoids excessive costs in providing public services and facilities for developments outside of urban boundaries.

Developing: Areas likely to become urbanized and require urban services in the next 20 years.

New development should be planned with mixed uses, blending residential development with schools, parks, recreation, retail business and services; linked in a compact pattern that encourages walking and minimizes the need for auto trips. Policies should include connectivity and continuity between planned developments. Safe and reliable vehicular and pedestrian or bicycle connections to retail and commercial services as well as internal street connectivity, connectivity to adjacent subdivisions, and multiple site access points are basic elements for establishing quality growth.



Author: CRC

Future Development Patterns

June 2015

Areas Requiring Special Attention

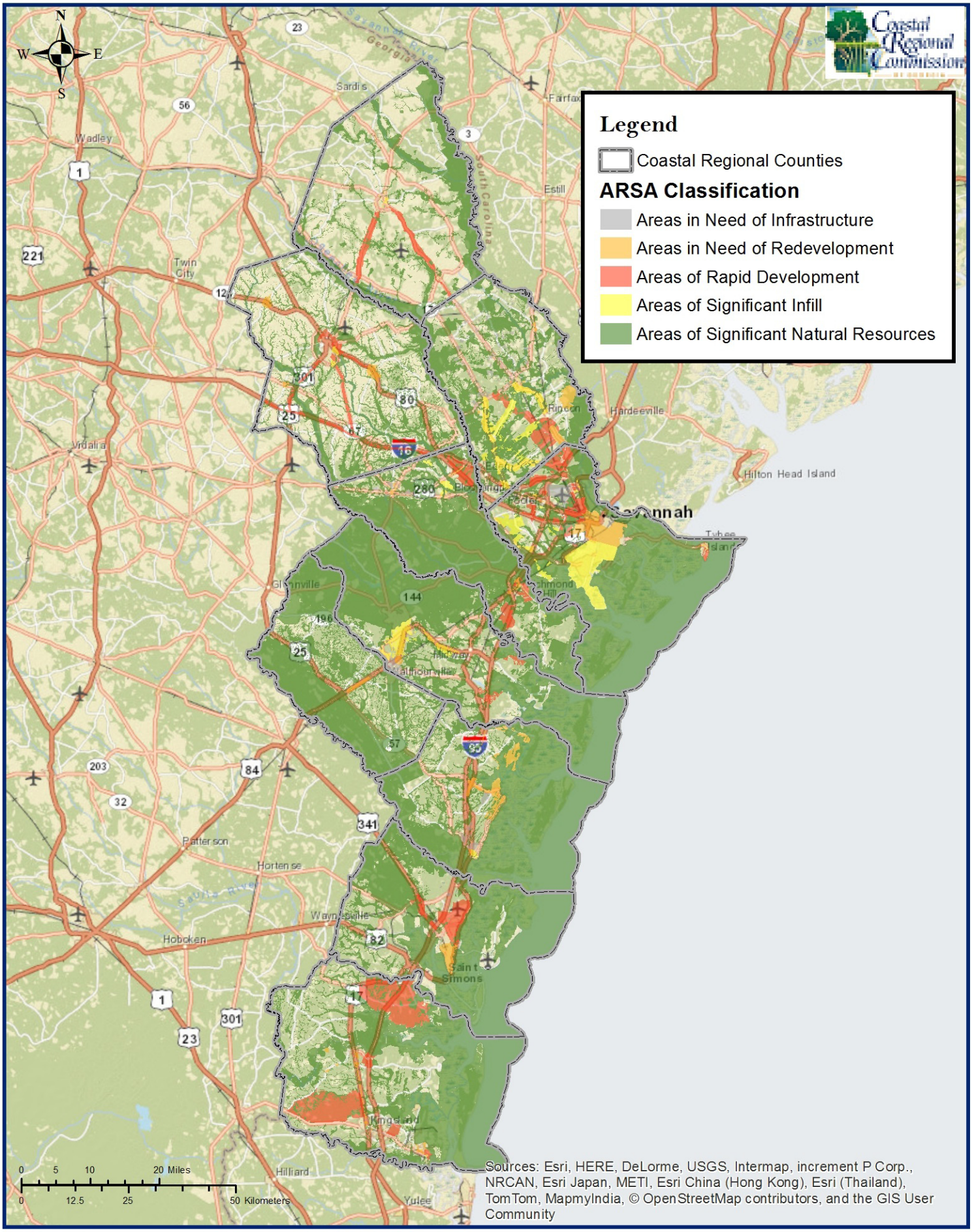
Considering the **Projected Development Patterns Map** and other sources, land use trends are evaluated within the region to identify areas requiring special attention, including:

- Areas identified on the Regionally Important Resources map;
- Areas where significant natural or cultural resources are likely to be impacted by development;
- Areas where rapid development or change of land uses are likely to occur, especially where the pace of development has and/or may outpace the availability of community facilities and services, including transportation;
- Areas in need of redevelopment and/or significant improvements to aesthetics or attractiveness (including strip commercial corridors);
- Areas with significant infill development opportunities, including scattered vacant sites, large abandoned structures, or sites that may be environmentally contaminated; and
- Areas of significant disinvestment, levels of poverty, and/or unemployment substantially higher than average levels for the region as a whole.

Characteristics of an individual or a group can affect the manner in which they prepare for a potential disaster. Their level of response can have a significant impact on their personal well-being as well as the success of a community. The purpose of this Assessment identified and mapped the following areas of special attention, specifically the vulnerable populations as it relates to natural hazards and resiliency.

- Map 1 - County **population growth greater than the 15% regional average**, 2000-2010
- Map 2 – County **population growth greater than the projected 32% regional average**, 2010-2030
- Map 3 - County **population under 5 greater than the 8% regional average**, 2010

- Map 4 - County **population aged 65+** greater than the **11% regional average**, 2010
- Map 5 - Census tracts where **population aged under 5** is above county's average
- Map 6 - Census tracts where **population aged 65+** is above county's average
- Map 7 - Census tracts where **median family income rate** is below county's average low/mod income level
- Map 8 - Census tracts where **family poverty rate** is above county's average
- Map 9 - Census tracts where **percentage of households without vehicles** is above county's average
- Map 10 - Census tracts where **percentage of mobile homes** is above county's average



Author: CRC

Areas Requiring Special Attention

June 2015

Supporting Analysis of Data and Information

Vulnerability Assessment

Like many coastal regions sea level rise and hurricanes present a prevailing issue within this developing coast. Because of Georgia's low coastal elevation, it is susceptible to the effects of detrimental flooding occurring due to storm surges from hurricanes. Listed below are the region's coastal counties and each county's vulnerability as outlined by *FEMA, Task 5, and Section 4: Conduct Risk Assessment, Summarize Vulnerability.*

The vulnerability ranking is given a color coded system with red the most likely and most hazardous; and blue ranking as negligible with damage being unpredictable in severity. Each extent, location, and hazard probability utilized the description outlined in *FEMA Task 5-3, Conduct Risk Assessment Analyze Risk.* For the purposes of this assessment, sea level rise is assessed for a 6ft rise in 2100 as the extreme prediction by NOAA. (Appendix A).

Results are summarized by an index of risk, vulnerability, and resilience, which varies with each theme or topic (e.g. built environment, infrastructure, and natural environment) and based on a ranking system. This system addresses the level of risk and vulnerability by county or by hazard area, and provides how resilient a community is to any future hazards.

Natural Hazards

Bryan County

According to the research conducted by the College of Environment + Design, Bryan County is affected by the possibility of extreme drought to due to the low precipitation levels throughout the county. Only a small amount of the County is within the floodplain and flooding is only likely in that area.

Hurricanes, and storm surges are considered highly likely. The storm surge during a category 5 can reach up to 31 feet as predicted by National Oceanic and Atmospheric Administration (NOAA).

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	Bryan	county wide, extensive	extreme	Likely	
Extreme Cold	Bryan	entire county, extensive	3°F, weak	unlikely	
Extreme Heat	Bryan	entire county, extensive	105°F, moderate	occasional	
Flood	Bryan	part of county, significant	severe	Likely	
Hurricane	Bryan	county wide, extensive	category 5, extreme	occasional	
Lightning	Bryan	negligible	weak to moderate	occasional	
Sea Level Rise	Bryan	county wide, extensive	6 ft, extreme	highly likely	
Storm Surge	Bryan	county wide, extensive	Category 5/ 31 ft, extreme	highly likely	
Wildfire	Bryan	parts of county, negligible	405.6 acres, weak	high in times of drought, likely	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.1 FEMA Hazard Summary Worksheet 5.1 for Bryan County.

Camden County

Natural Hazard

According to the research by the College of Environment + Design, flooding in Camden County is an extreme occurrence due to most of the county lying within the flood plain. However, during periods of drought due to low precipitation for the region, wildfires are a likely probability. A hurricane in Camden County can have severe repercussions with a Category 5 hurricane creating a 31 foot storm surge as predicted by NOAA.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	Camden	County wide, extensive	Extreme	Likely	
Extreme Cold	Camden	Entire county, extensive	4°F, weak	Unlikely	
Extreme Heat	Camden	Entire county, extensive	104°F, moderate	Occasional	
Flood	Camden	Parts of county, significant	Severe	Highly Likely	
Hurricane	Camden	County wide, extensive	Category 5	Occasional	
Lightning	Camden	Negligible	Weak to moderate	Occasional	
Sea Level Rise	Camden	County wide, extensive	6 ft, extreme	Highly Likely	
Storm Surge	Camden	County wide, extensive	Category 5, 31 ft, extreme	Highly Likely	
Wildfire	Camden	Parts of county, negligible	No information available	High in times of extreme drought	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.2 FEMA Hazard Summary Worksheet for Camden County.

Chatham County

Natural Hazards

According to the research by the College of Environment + Design, Chatham County's main natural hazard threats are hurricanes, flooding, sea level rise, and storm surges. Chatham County has risk of severe flooding especially during times of hurricanes, storm surges, and sea level rise as these factors increase the likelihood of county-wide flooding. Additionally, flooding is an extreme occurrence due to most of the county lying within the flood plain.

A hurricane of any category can make landfall on the county. The storm surge caused by hurricanes can reach levels of 31 feet as predicted by NOAA. These storm surges can cover most of the county during a Category 5 hurricane.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	Chatham	county wide, extensive	extreme	Likely	
Extreme Cold	Chatham	Savannah area-entire county, extensive	3°F, weak	unlikely	
Extreme Heat	Chatham	Savannah area-entire county, extensive	105°F, moderate	occasional	
Flood	Chatham	significant, covers a large portion of county	severe	highly likely	
Hurricane	Chatham	county wide, extensive	Category 5, extreme	occasional	
Lightning	Chatham	negligible	weak to moderate	occasional	
Sea Level Rise	Chatham	county wide, extensive	6 ft, extreme	highly likely	
Storm Surge	Chatham	county wide, extensive	Category 5/ 31 ft, extreme	highly likely	
Wildfire	Chatham	parts of county, negligible	1217.21 acres burned, moderate to severe	high in times of drought, likely	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.3 FEMA Hazard Summary Worksheet for Chatham County

Glynn County

Natural Hazards

According to the research by the College of Environment + Design, floods, hurricanes, storm surges, and sea level rise are highly likely and considered the most severe for Glynn County. A Category 5 hurricane can cause 31 foot storm surges as predicted by NOAA. These storm surges can flood cover most of the county. During periods of precipitation there is a likely risk of extreme drought.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	Glynn	County wide, extensive	Extreme	Likely	
Extreme Cold	Glynn	Entire county, extensive	5°F, weak	Unlikely	
Extreme Heat	Glynn	Entire county, extensive	106°F, moderate	Occasional	
Flood	Glynn	Part of county, significant	Severe	Highly Likely	
Hurricane	Glynn	County wide, extensive	Category 5	Occasional	
Lightning	Glynn	Negligible	Weak to moderate	Occasional	
Sea Level Rise	Glynn	County wide, extensive	6 ft, extreme	Highly Likely	
Storm Surge	Glynn	county wide, extensive	Category 5, 31 ft extreme	Highly Likely	
Wildfire	Glynn	parts of county, negligible	No information available	High in times of extreme drought	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.4 FEMA Hazard Summary Worksheet 5.1 for Glynn County

Liberty County

Natural Hazards

According to the research by the College of Environment + Design, Liberty County is likely affected by extreme drought due to its low precipitation levels. Hurricanes, sea level rise, and storm surges are highly likely within this area due to the large portion of the county that all three disasters can affect. A Category 5 hurricane can bring 31 foot storm surge as predicted by NOAA.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	Liberty	county wide, extensive	extreme	Likely	
Extreme Cold	Liberty	entire county, extensive	3°F, weak	unlikely	
Extreme Heat	Liberty	entire county, extensive	105°F, moderate	occasional	
Flood	Liberty	part of county, significant	severe	highly likely	
Hurricane	Liberty	county wide, extensive	category 5, extreme	occasional	
Lightning	Liberty	negligible	weak to moderate	occasional	
Sea Level Rise	Liberty	county wide, extensive	6 ft, extreme	highly likely	
Storm Surge	Liberty	county wide, extensive	Category 5/ 31 ft, extreme	highly likely	
Wildfire	Liberty	parts of county, negligible	893.42 acres, weak to moderate	high in times of drought, likely	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.5 FEMA Hazard Summary Worksheet 5.1 for Liberty County

McIntosh County

Natural Hazards

According to the research by the College of Environment + Design, McIntosh County can suffer from extreme drought due to the low precipitation levels of the region. Flooding is highly likely due to large portions of the county lying within the flood plain. Hurricanes can become a Category 5 with a 31 foot storm surge as predicted by NOAA.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	McIntosh	County wide, extensive	Extreme	Likely	
Extreme Cold	McIntosh	Entire county, extensive	3°F, weak	Unlikely	
Extreme Heat	McIntosh	Entire county, extensive	105°F, moderate	Occasional	
Flood	McIntosh	Part of county, significant	Severe	Highly Likely	
Hurricane	McIntosh	County wide, extensive	Category 5	Occasional	
Lightning	McIntosh	Negligible	weak to moderate	Occasional	
Sea Level Rise	McIntosh	County wide, extensive	6 ft, extreme	Highly Likely	
Storm Surge	McIntosh	county wide, extensive	Category 5; 31 ft, extreme	Highly Likely	
Wildfire	McIntosh	parts of county, negligible	933.11 acres, severe	High in times of extreme drought, likely	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.6 FEMA Hazard Summary Worksheet 5.1 for McIntosh County

Natural Environment

The assessment for the region includes the following natural features: hydrology, wetlands and riparian zones, water recharge areas, critical vegetation habitats, areas of development/disturbance, and conservation land. Through identification of valuable and critical areas, other key natural features and processes are addressed indirectly including: soil and erosion, storm water runoff, and continuous wildlife corridors.

Georgia tides represent a dynamic process for the marsh ecosystem. Incoming tides provide food for the grasses of the marsh while outgoing tides carry food and nutrients produced by the marsh to the sea. The coming together of these two water sources provides critical habitat for fish, turtles, birds, mammals and the fisheries of Georgia. Seventy percent of Georgia's fish, shrimp, crabs, and shellfish spend a portion of their life in the estuarine waters of the salt marshes. These estuaries are nutrient driven by tidal waters which average 6.5 feet twice a day. During king tides these tides can average 10 feet.

Maritime dunes lie landward of the coastal beaches and seaward of the maritime forests. The dunes closest to the beach are vegetated by salt-tolerant species that provide nesting habitat for a variety of animals, such as loggerhead and leatherback turtles. Maritime dunes are among the most picturesque and heavily visited environments of the coastal region; protecting their economic value depends on also conserving their ecological values. Sand sharing, sediment transport, and longshore currents are natural processes that sustain maritime dunes. Limiting coastal development, channelization of coastal rivers, upstream impoundment, and seawall/jetty construction protects from interference with the natural movement of sand, sediments, and currents.

Additionally the wetlands, marshes, and riparian zones act as buffers against offshore storms. The vegetation has a dissipating effect on wave intensity. Hurricanes and storm surges would have larger negative impacts to infrastructure without natural marshes and vegetation. Management of salt marshes, wetlands, and riparian zones should be integrated into coastal hazard mitigation plans and sea level rise adaptation policies.

Storm Surge and Development

Inundation zone 1, also referred to as storm surge zone, shows that Glynn County has the most coverage of developed area, approximately fifteen percent. All other counties reveal that development is below ten percent within storm surge zone 1.

Storm surge zone 2 shows that the percent of developed land increases. Camden, Chatham, and McIntosh contain twenty to thirty percent of developed land and Glynn County contains forty percent development.

Chatham and McIntosh show an increase in development at thirty percent for storm surge zone 3. Camden, Glynn and Liberty counties are fifteen to twenty-five percent developed.

In inundation zone 4, the development coverage decreases to fewer than twenty percent. In inundation zone 5, the development coverage is equal to or less than ten percent.

Tropical storm and inundation 1 zone should limit development. The inundation zone 2 and 3 have the most developed coverage that should be considered in resiliency planning as Figure 1.2.1.

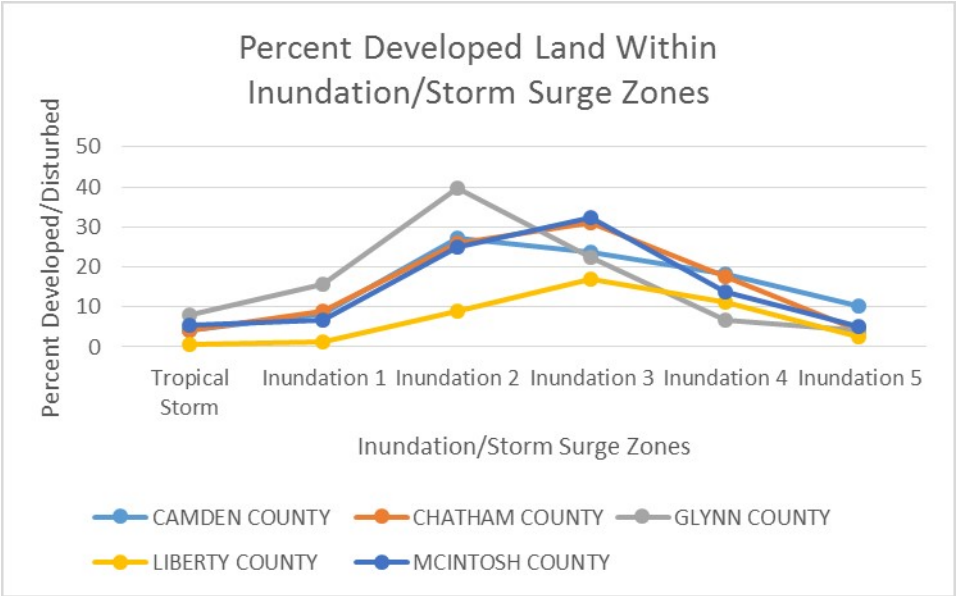


Figure 1.2.1

Vegetation/Open Water Buffers

Riparian buffers can be given a value based on their presence and allowance from open water and wetlands towards the built and developed environment. Three categories of consideration include: 100, 150, and 200-foot riparian buffers. A 100-foot riparian buffer is the recommended minimum based on literature reviews by the scientific community. As reported by the U.S. Agriculture and U.S. Environmental Protection agency in 1997, there are specific riparian widths that are associated with specific objectives. The recommended buffer width for flood control should be up 200 feet. This buffer width provides flood and sediment control as well as wildlife habitat.

Buffers narrower than 35 feet can provide some limited benefits but may require long-term maintenance since their ability to trap sediments is reduced (Giovengo, 2012). Currently, **The Soil Erosion and Sedimentation Act of Georgia** sets minimum standards for land-disturbing activities that counties enforce. Counties and municipalities must adopt comprehensive ordinances that establish procedures for controlling land-disturbing activities. One requirement is the installation of best management practices that avoid soil erosion caused by storm water runoff. Another aspect of the act requires that no land-disturbing activities be undertaken within 25 feet from state waters.

Five counties have approximately ninety percent vegetation within the 100-foot riparian buffer as noted in Figure 1.2.2. Within the 150-foot riparian buffer the vegetation coverage decreases slightly. The largest decrease in vegetation is within Glynn and Chatham Counties that declines from around eighty percent to seventy percent and sixty percent respectively. McIntosh and Liberty County's vegetation coverage does not change drastically, staying between ninety and eighty percent. This represents the effects of development and the importance of maintaining buffers on the riparian zone for protection of vegetation and hydrology. The expanding built environment continues to threaten the natural environment. The state currently mandates a 25-foot buffer from hydrology, which is inadequate for protecting the vital natural system.

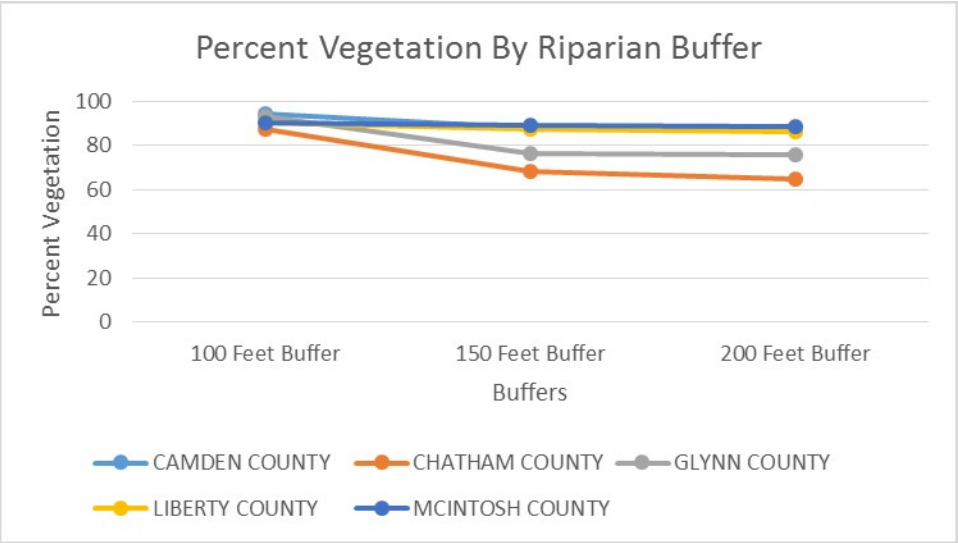


Figure 1.2.2 Data derived from GIS vegetation data provided by DNR. Bryan County is not included because there is no vegetation data provided.

Vulnerable Populations

A key factor in examining resiliency is understanding and quantifying vulnerable populations. These populations include not only those residents who live in vulnerable areas, the 100-year and 500-year flood plains, but also those who may have difficulty in heeding evacuation orders due to age, income, and mobility.

Provided below are county snapshots identifying these most vulnerable populations. These groups included children less than five years old, the elderly and frail elderly, persons living in poverty, and persons without reliable transportation that live in communities with limited public transportation. For elderly, we have identified the percentage of the population 65 and older. There is no specific age cohort for frail elderly, but the literature defines frailty in people 65 and older that called for the diagnosis when three or more of the following five criteria were present: unintentional weight loss of 10 pounds or more in the past year, self-reported exhaustion, weakness as measured by grip strength, slow walking speed and low physical activity. The frail elderly are individuals, over 65 years of age, dependent on others for activities of daily living, and often in institutional care.[1] For

[1] "A Firm Diagnosis of Frailty," New York Times, Karen Pennar, June 25, 2012; "Who Are the Frail Elderly," Quarterly Journal of Medicine, New Series 68, No. 255, pp. 505-506, July 1988.

evidence of reliable transportation we used U. S. Census data showing the percentage of households that do not have a vehicle available. Also included are percentages of families who live in mobile homes as these are considered particularly vulnerable in the event of a storm or other natural disaster.

Bryan County Snapshot

Population Growth

The population of Bryan County grew from 23,417 to 30,233 between 2000 and 2010. The population is projected to grow to 45,272 by 2020 and to 59,534 by 2030. This represents a growth rate of 23percent between the two most recent census counts, and a projected growth of 49percent from the current census count to 2030.

Bryan County Population Growth			
2000	**2010**	**2020**	**2030**
23,417	30,233	45,272	59,534
Source: U. S. Census; Georgia Office of Planning and Budget			

Age Vulnerable Populations

In Bryan County the percentage of children under 5 grew by 18percent from 2000 to 2010, while the percentage of persons 65 and older grew by 37percent during the same period.

Bryan County Age Vulnerable Populations			
	2000	**2010**	**Percent Change**
Children under 5	1,800	2,203	18percent
Persons 65 and older	1,703	2,715	37percent
Source: U. S. Census			

Income and Poverty Level

Income can directly relate to a family's ability to have reliable transportation, which then directly relates to a family's ability to evacuate their homes in the event of an evacuation order. Income also impinges upon a family's ability to secure temporary lodging (hotels or

motels) beyond publically provided shelter, or to obtain replacement housing should they lose their homes due to a storm event or natural disaster.

According to the U. S. Census' American Community Survey 2013 – Economic Characteristics, Bryan County's Median Family Income (MFI) is $74,513. Low- and moderate-income (LMI) is defined as up to 80percent of MFI, which would be $59,610 for Bryan County. Poverty levels are established by the federal government and are based upon income and family size. For Bryan County, 31percent of the population is LMI and 8.6percent of families fall below the poverty level.

Means of Transportation

The U. S. Census reports on the number of vehicles available to households. This is an important indicator of the percentage of the population that has reliable transportation should they need to evacuate their homes in the event of a storm or other natural disaster. In Bryan County 3.1percent of households do not have a vehicle available.

Housing Type

Mobile homes have been identified as a particularly vulnerable type of housing during storm events due to their susceptibility to damage caused by high winds and flying debris. In Bryan County 13.9percent of families live in mobile homes.

Bulloch County Snapshot

Population Growth

The population of Bulloch County grew from 55,983 to 70,217 between 2000 and 2010. The population is projected to grow to 88,071 by 2020 and to 109,034 by 2030. This represents a growth rate of 20percent between the two most recent census counts, and a projected growth of 36percent from the current census count to 2030.

Bulloch County Population Growth			
2000	**2010**	**2020**	**2030**
55,983	70,217	88,071	109,034
Source: U. S. Census; Georgia Office of Planning and Budget			

Age Vulnerable Populations

In Bulloch County the percentage of children under 5 grew by 22percent from 2000 to 2010, while the percentage of persons 65 and older grew by 19percent during the same period.

Bulloch County Age Vulnerable Populations			
	2000	**2010**	**Percent Change**
Children under 5	3261	4197	22percent
Persons 65 and older	5207	6401	19percent
Source: U. S. Census			

Income and Poverty Level

Income can directly relate to a family's ability to have reliable transportation, which then directly relates to a family's ability to evacuate their homes in the event of an evacuation order. Income also impinges upon a family's ability to secure temporary lodging (hotels or motels) beyond publically provided shelter, or to obtain replacement housing should they lose their homes due to a storm event or natural disaster.

According to the U. S. Census' American Community Survey 2013 – Economic Characteristics, Bulloch County's Median Family Income (MFI) is $52, 100. Low- and moderate-income (LMI) is defined as up to 80percent of MFI, which would be $41,680 for Bulloch County. Poverty levels are established by the federal government and are based upon income and family size. For Bulloch County, 35percent of the population is LMI and 16.3percent of families fall below the poverty level.

Means of Transportation

The U. S. Census reports on the number of vehicles available to households. This is an important indicator of the percentage of the population that has reliable transportation should they need to evacuate their homes in the event of a storm or other natural disaster. In Bulloch County 6.1percent of households do not have a vehicle available.

Housing Type

Mobile homes have been identified as a particularly vulnerable type of housing during storm events due to their susceptibility to damage caused by high winds and flying debris. In Bulloch County 18.3percent of families live in mobile homes.

Camden County Snapshot

Population Growth

The population of Camden County grew from 43,664 to 50,513 between 2000 and 2010. The population is projected to grow to 70,548 by 2020 and to 96,743 by 2030. This represents a growth rate of 14percent between the two most recent census counts, and a projected growth of 48percent from the current census count to 2030.

Camden County Population Growth			
2000	**2010**	**2020**	**2030**
43,664	50,513	70,548	96,743
Source: U. S. Census; Georgia Office of Planning and Budget			

Age Vulnerable Populations

In Camden County the percentage of children under 5 grew by 4percent from 2000 to 2010, while the percentage of persons 65 and older grew by 50percent during the same period.

Camden County Age Vulnerable Populations			
	2000	**2010**	**Percent Change**
Children under 5	3,804	3,983	4percent
Persons 65 and older	2,277	4,556	50percent
Source: U. S. Census			

Income and Poverty Level

Income can directly relate to a family's ability to have reliable transportation, which then directly relates to a family's ability to evacuate their homes in the event of an evacuation order. Income also impinges upon a family's ability to secure temporary lodging (hotels or motels) beyond publically provided shelter, or to obtain replacement housing should they lose their homes due to a storm event or natural disaster.

According to the U. S. Census' American Community Survey 2013 – Economic Characteristics, Camden County's Median Family Income (MFI) is $60,101. Low- and moderate-income (LMI) is defined as up to 80percent of MFI, which would be $48,081 for Camden County. Poverty levels are established by the federal government and are based upon income and family size. For Camden County, 39percent of the population is LMI and 13.7percent of families fall below the poverty level.

Means of Transportation

The U. S. Census reports on the number of vehicles available to households. This is an important indicator of the percentage of the population that has reliable transportation should they need to evacuate their homes in the event of a storm or other natural disaster. In Camden County 5.3percent of households do not have a vehicle available.

Housing Type

Mobile homes have been identified as a particularly vulnerable type of housing during storm events due to their susceptibility to damage caused by high winds and flying debris. In Camden County 14.2percent of families live in mobile homes.

Chatham County Snapshot

Population Growth

The population of Chatham County grew from 232,048 to 265,128 between 2000 and 2010. The population is projected to grow to 290,615 by 2020 and to 324,098 by 2030. This represents a growth rate of 12percent between the two most recent census counts, and a projected growth of 18percent from the current census count to 2030.

Chatham County Population Growth			
2000	**2010**	**2020**	**2030**
232,048	265,128	290,615	324,098
Source: U. S. Census; Georgia Office of Planning and Budget			

Age Vulnerable Populations

In Chatham County the percentage of children under 5 grew by 15percent from 2000 to 2010, while the percentage of persons 65 and older grew by 9percent during the same period.

Chatham County Age Vulnerable Populations			
	2000	**2010**	**Percent Change**
Children under 5	15,663	18,526	15percent
Persons 65 and older	29,770	32,864	9percent
Source: U. S. Census			

Income and Poverty Level

Income can directly relate to a family's ability to have reliable transportation, which then directly relates to a family's ability to evacuate their homes in the event of an evacuation order. Income also impinges upon a family's ability to secure temporary lodging (hotels or motels) beyond publically provided shelter, or to obtain replacement housing should they lose their homes due to a storm event or natural disaster.

According to the U. S. Census' American Community Survey 2013 – Economic Characteristics, Chatham County's Median Family Income (MFI) is $55,978. Low- and moderate-income (LMI) is defined as up to 80percent of MFI, which would be $44,782 for Chatham County. Poverty levels are established by the federal government and are based upon income and family size. For Chatham County, 44percent of the population is LMI and 13.5percent of families fall below the poverty level.

Means of Transportation

The U. S. Census reports on the number of vehicles available to households. This is an important indicator of the percentage of the population that has reliable transportation should they need to evacuate their homes in the event of a storm or other natural disaster. In Chatham County 7.9percent of households do not have a vehicle available.

Housing Type

Mobile homes have been identified as a particularly vulnerable type of housing during storm events due to their susceptibility to damage caused by high winds and flying debris. In Chatham County 4.6percent of families live in mobile homes.

Effingham County Snapshot

Population Growth

The population of Effingham County grew from 37,535 to 52,250 between 2000 and 2010. The population is projected to grow to 80,563 by 2020 and to 112,062 by 2030. This represents a growth rate of 28percent between the two most recent census counts, and a projected growth of 53percent from the current census count to 2030.

Effingham County Population Growth			
2000	**2010**	**2020**	**2030**
37,535	52,250	80,563	112,062
Source: U. S. Census; Georgia Office of Planning and Budget			

Age Vulnerable Populations

In Effingham County the percentage of children under 5 grew by 22percent from 2000 to 2010, while the percentage of persons 65 and older grew by 37percent during the same period.

Effingham County Age Vulnerable Populations			
	2000	**2010**	**Percent Change**
Children under 5	2,857	3,668	22percent
Persons 65 and older	3,016	4,763	37percent
Source: U. S. Census			

Income and Poverty Level

Income can directly relate to a family's ability to have reliable transportation, which then directly relates to a family's ability to evacuate their homes in the event of an evacuation order. Income also impinges upon a family's ability to secure temporary lodging (hotels or

motels) beyond publically provided shelter, or to obtain replacement housing should they lose their homes due to a storm event or natural disaster.

According to the U. S. Census' American Community Survey 2013 – Economic Characteristics, Effingham County's Median Family Income (MFI) is $69,450. Low- and moderate-income (LMI) is defined as up to 80percent of MFI, which would be $55,560 for Effingham County. Poverty levels are established by the federal government and are based upon income and family size. For Effingham County, 32percent of the population is LMI and 7.9percent of families fall below the poverty level.

Means of Transportation

The U. S. Census reports on the number of vehicles available to households. This is an important indicator of the percentage of the population that has reliable transportation should they need to evacuate their homes in the event of a storm or other natural disaster. In Effingham County 3.6percent of households do not have a vehicle available.

Housing Type

Mobile homes have been identified as a particularly vulnerable type of housing during storm events due to their susceptibility to damage caused by high winds and flying debris. In Effingham County 24percent of families live in mobile homes.

Glynn County Snapshot

Population Growth

The population of Glynn County grew from 67,568 to 79,626 between 2000 and 2010. The population is projected to grow to 93,461 by 2020 and to 109,771 by 2030. This represents a growth rate of 15percent between the two most recent census counts, and a projected growth of 27percent from the current census count to 2030.

Glynn County Population Growth			
2000	**2010**	**2020**	**2030**
67,568	79,626	93,461	109,771
Source: U. S. Census; Georgia Office of Planning and Budget			

Age Vulnerable Populations

In Glynn County the percentage of children under 5 grew by 18percent from 2000 to 2010, while the percentage of persons 65 and older grew by 18percent during the same period.

Glynn County Age Vulnerable Populations			
	2000	**2010**	**Percent Change**
Children under 5	4398	5352	18%
Persons 65 and older	9761	11976	18%
Source: U. S. Census			

Income and Poverty Level

Income can directly relate to a family's ability to have reliable transportation, which then directly relates to a family's ability to evacuate their homes in the event of an evacuation order. Income also impinges upon a family's ability to secure temporary lodging (hotels or motels) beyond publically provided shelter, or to obtain replacement housing should they lose their homes due to a storm event or natural disaster.

According to the U. S. Census' American Community Survey 2013 – Economic Characteristics, Glynn County's Median Family Income (MFI) is $56,221. Low- and moderate-income (LMI) is defined as up to 80percent of MFI, which would be $44,977 for Glynn County. Poverty levels are established by the federal government and are based upon income and family size. For Glynn County, 45percent of the population is LMI and 15.3percent of families fall below the poverty level.

Means of Transportation

The U. S. Census reports on the number of vehicles available to households. This is an important indicator of the percentage of the population that has reliable transportation should they need to evacuate their homes in the event of a storm or other natural disaster. In Glynn County 6percent of households do not have a vehicle available.

Housing Type

Mobile homes have been identified as a particularly vulnerable type of housing during storm events due to their susceptibility to damage caused by high winds and flying debris. In Glynn County 12.7percent of families live in mobile homes.

Liberty County Snapshot

Population Growth

The population of Liberty County grew from 61,610 to 63,453 between 2000 and 2010. The population is projected to grow to 78,740 by 2020 and to 93,821 by 2030. This represents a growth rate of 3% between the two most recent census counts, and a projected growth of 32% from the current census count to 2030.

Liberty County Population Growth			
2000	**2010**	**2020**	**2030**
61,610	63,453	78,740	93,821
Source: U. S. Census; Georgia Office of Planning and Budget			

Age Vulnerable Populations

In Liberty County the percentage of children under 5 grew by 2% from 2000 to 2010, while the percentage of persons 65 and older grew by 39% during the same period.

Liberty County Age Vulnerable Populations			
	2000	**2010**	**Percent Change**
Children under 5	6,412	6,552	2%
Persons 65 and older	2,432	3,971	39%
Source: U. S. Census			

Income and Poverty Level

Income can directly relate to a family's ability to have reliable transportation, which then directly relates to a family's ability to evacuate their homes in the event of an evacuation order. Income also impinges upon a family's ability to secure temporary lodging (hotels or motels) beyond publically provided shelter, or to obtain replacement housing should they lose their homes due to a storm event or natural disaster.

Long County Snapshot

Population Growth

The population of Long County grew from 10,304 to 14,464 between 2000 and 2010. The population is projected to be 14,386 in 2020 and to grow to 17,171 by 2030. This represents a growth rate of 29percent between the two most recent census counts, and a projected growth of 16percent from the current census count to 2030.

Long County Population Growth			
2000	**2010**	**2020**	**2030**
10,304	14,464	14,386	17,171
Source: U. S. Census; Georgia Office of Planning and Budget			

Age Vulnerable Populations

In Long County the percentage of children under 5 grew by 16percent from 2000 to 2010, while the percentage of persons 65 and older grew by 44percent during the same period.

Long County Age Vulnerable Populations			
	2000	**2010**	**Percent Change**
Children under 5	1,133	1,355	16%
Persons 65 and older	594	1,055	44%
Source: U. S. Census			

Income and Poverty Level

Income can directly relate to a family's ability to have reliable transportation, which then directly relates to a family's ability to evacuate their homes in the event of an evacuation order. Income also impinges upon a family's ability to secure temporary lodging (hotels or motels) beyond publically provided shelter, or to obtain replacement housing should they lose their homes due to a storm event or natural disaster.

According to the U. S. Census' American Community Survey 2013 – Economic Characteristics, Long County's Median Family Income (MFI) is $50,522. Low- and moderate-income (LMI) is defined as up to 80percent of MFI, which would be $40,418 for Long County. Poverty levels are established by the federal government and are based upon

income and family size. For Long County, 33percent of the population is LMI and 17percent of families fall below the poverty level.

Means of Transportation

The U. S. Census reports on the number of vehicles available to households. This is an important indicator of the percentage of the population that has reliable transportation should they need to evacuate their homes in the event of a storm or other natural disaster. In Long County 6.5percent of households do not have a vehicle available.

Housing Type

Mobile homes have been identified as a particularly vulnerable type of housing during storm events due to their susceptibility to damage caused by high winds and flying debris. In Long County 49.2percent of families live in mobile homes.

McIntosh County Snapshot

Population Growth

The population of McIntosh County grew from 10,847 to 14,333 between 2000 and 2010. The population is projected to be 16,039 in 2020 and to grow to 20,686 by 2030. This represents a growth rate of 24percent between the two most recent census counts, and a projected growth of 31percent from the current census count to 2030.

McIntosh County Population Growth			
2000	**2010**	**2020**	**2030**
10,847	14,333	16,039	20,686
Source: U. S. Census; Georgia Office of Planning and Budget			

Age Vulnerable Populations

In McIntosh County the percentage of children under 5 grew by 9percent from 2000 to 2010, while the percentage of persons 65 and older grew by 48percent during the same period.

McIntosh County Age Vulnerable Populations			
	2000	**2010**	**Percent Change**
Children under 5	715	785	9%
Persons 65 and older	1,280	2,478	48%
Source: U. S. Census			

Income and Poverty Level

Income can directly relate to a family's ability to have reliable transportation, which then directly relates to a family's ability to evacuate their homes in the event of an evacuation order. Income also impinges upon a family's ability to secure temporary lodging (hotels or motels) beyond publically provided shelter, or to obtain replacement housing should they lose their homes due to a storm event or natural disaster.

According to the U. S. Census' American Community Survey 2013 – Economic Characteristics, McIntosh County's Median Family Income (MFI) is $54,036. Low- and moderate-income (LMI) is defined as up to 80percent of MFI, which would be $43,229 for McIntosh County. Poverty levels are established by the federal government and are based upon income and family size. For McIntosh County, 25percent of the population is LMI and 10.5percent of families fall below the poverty level.

Means of Transportation

The U. S. Census reports on the number of vehicles available to households. This is an important indicator of the percentage of the population that has reliable transportation should they need to evacuate their homes in the event of a storm or other natural disaster. In McIntosh County 5.2percent of households do not have a vehicle available.

Housing Type

Mobile homes have been identified as a particularly vulnerable type of housing during storm events due to their susceptibility to damage caused by high winds and flying debris. In McIntosh County 39.6percent of families live in mobile homes.

Screven County Snapshot

Population Growth

The population of Screven County decreased from 15,374 to 14,593 between 2000 and 2010. The population is projected to be 17,819 in 2020 and to grow to 20,036 by 2030. This represents a population loss of 5percent between the two most recent census counts, and a projected growth of 27percent from the current census count to 2030.

Screven County Population Growth			
2000	**2010**	**2020**	**2030**
15,374	14,593	17,819	20,036
Source: U. S. Census; Georgia Office of Planning and Budget			

Age Vulnerable Populations

In Screven County the percentage of children under 5 decreased by 2percent from 2000 to 2010, while the percentage of persons 65 and older grew by 1percent during the same period.

Screven County Age Vulnerable Populations			
	2000	**2010**	**Percent Change**
Children under 5	1,012	993	-2%
Persons 65 and older	2,155	2,174	1%
Source: U. S. Census			

Income and Poverty Level

Income can directly relate to a family's ability to have reliable transportation, which then directly relates to a family's ability to evacuate their homes in the event of an evacuation order. Income also impinges upon a family's ability to secure temporary lodging (hotels or motels) beyond publically provided shelter, or to obtain replacement housing should they lose their homes due to a storm event or natural disaster.

According to the U. S. Census' American Community Survey 2013 – Economic Characteristics, Screven County's Median Family Income (MFI) is $46,591. Low- and moderate-income (LMI) is defined as up to 80percent of MFI, which would be $37,273 for Screven County. Poverty levels are established by the federal government and are based

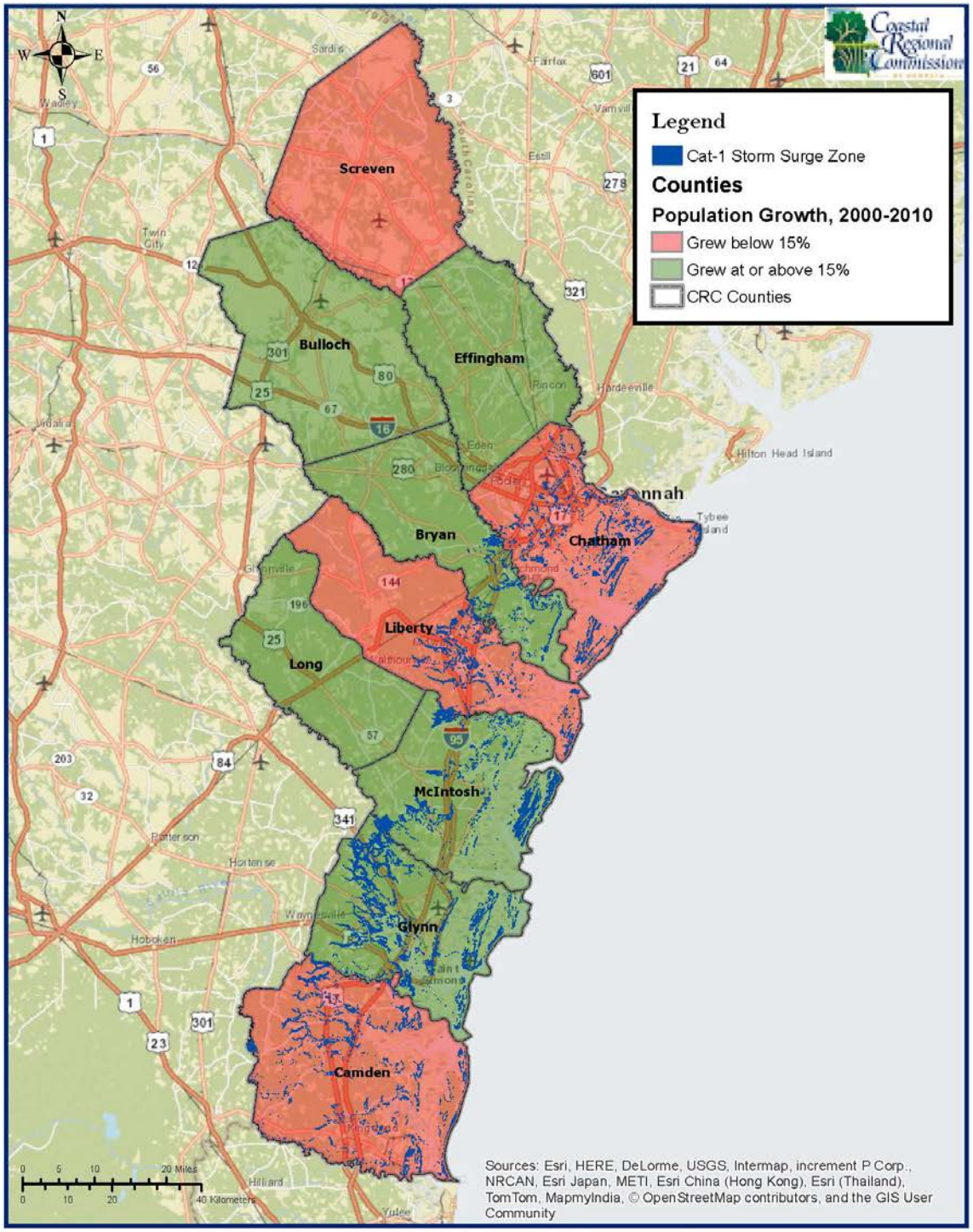
upon income and family size. For Screven County, 39percent of the population is LMI and 21percent of families fall below the poverty level.

Means of Transportation

The U. S. Census reports on the number of vehicles available to households. This is an important indicator of the percentage of the population that has reliable transportation should they need to evacuate their homes in the event of a storm or other natural disaster. In Screven County 10.1percent of households do not have a vehicle available.

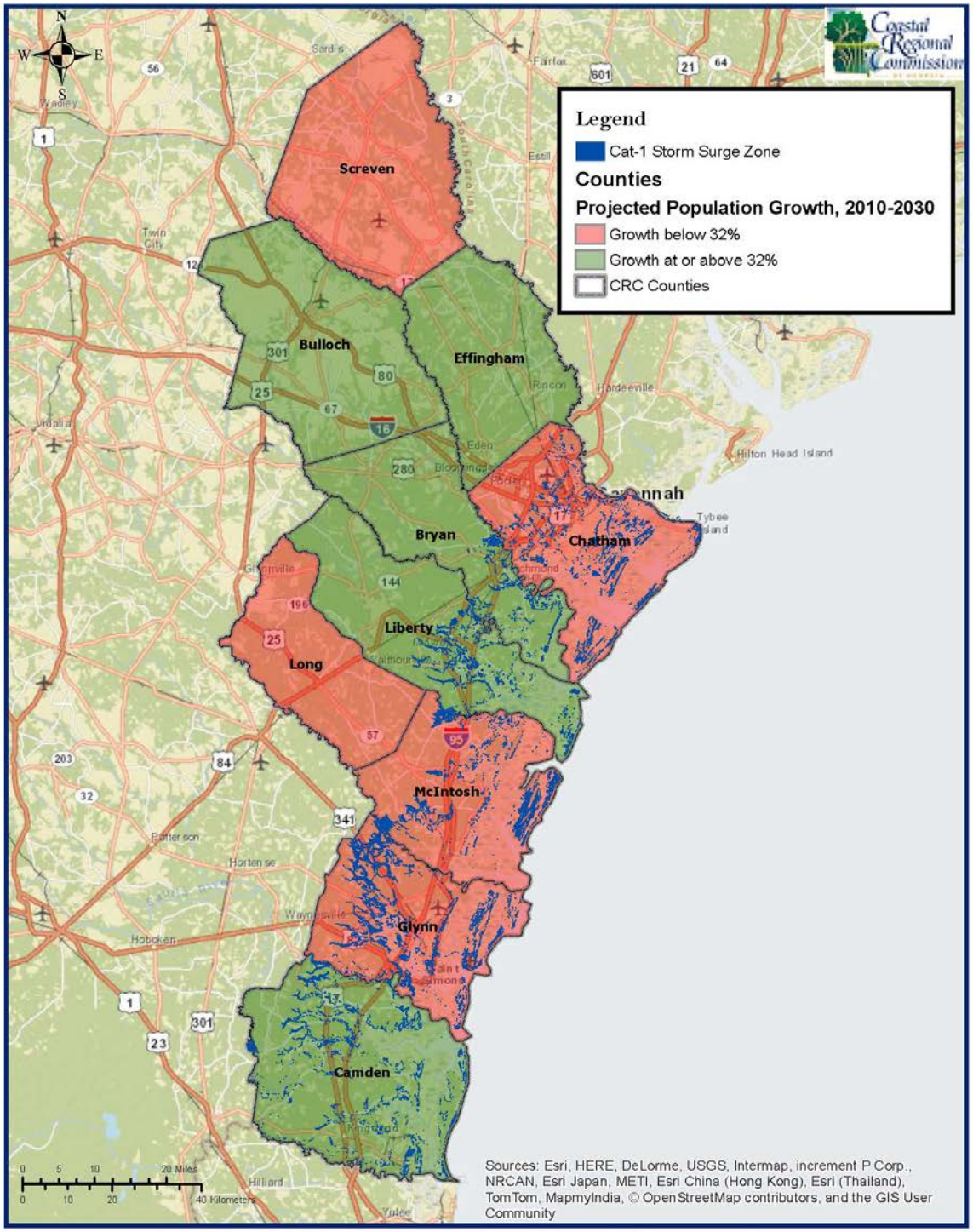
Housing Type

Mobile homes have been identified as a particularly vulnerable type of housing during storm events due to their susceptibility to damage caused by high winds and flying debris. In Screven County 34percent of families live in mobile homes.



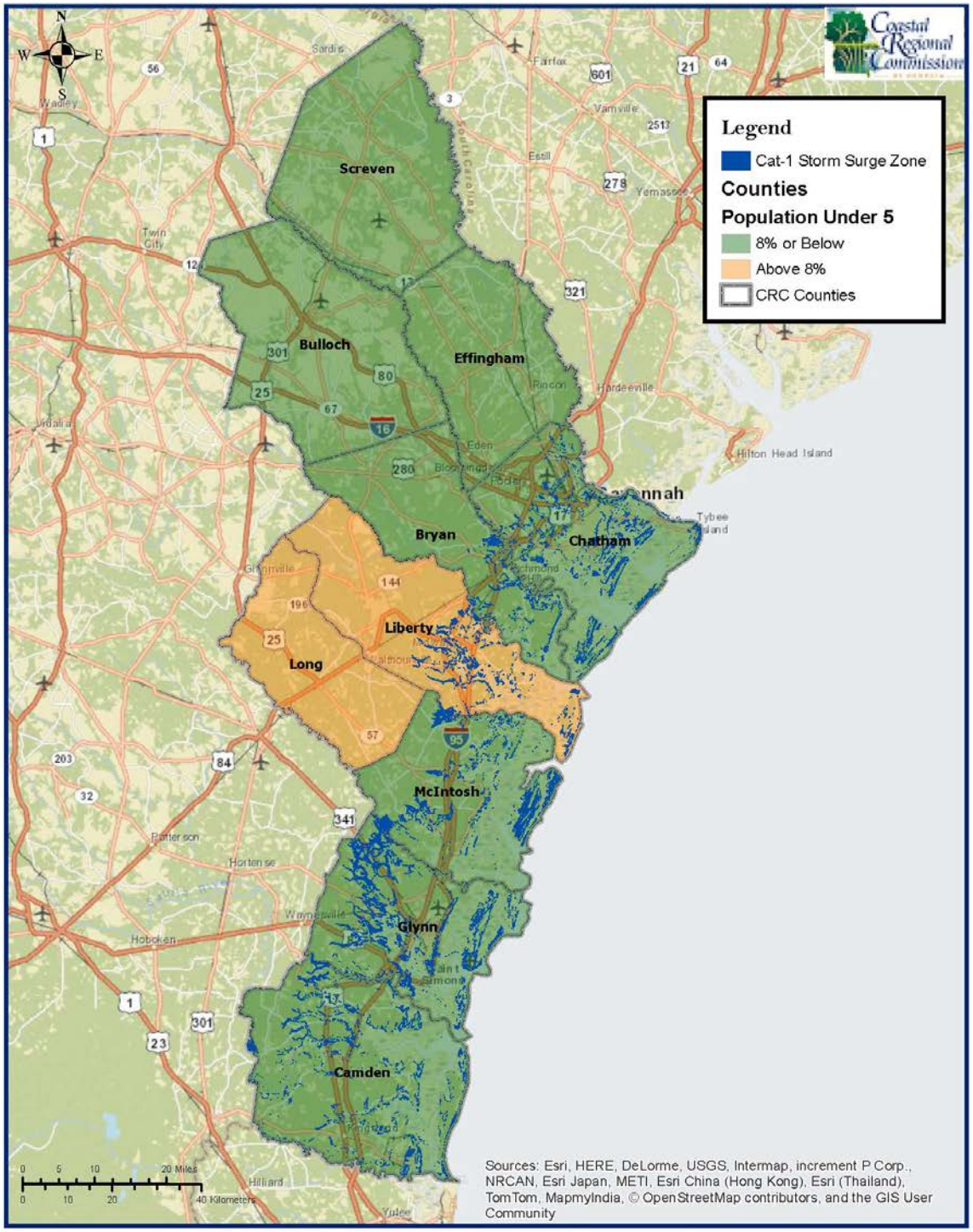
County Population Growth Compared to 15% Regional Average, 2000-2010

June 2015



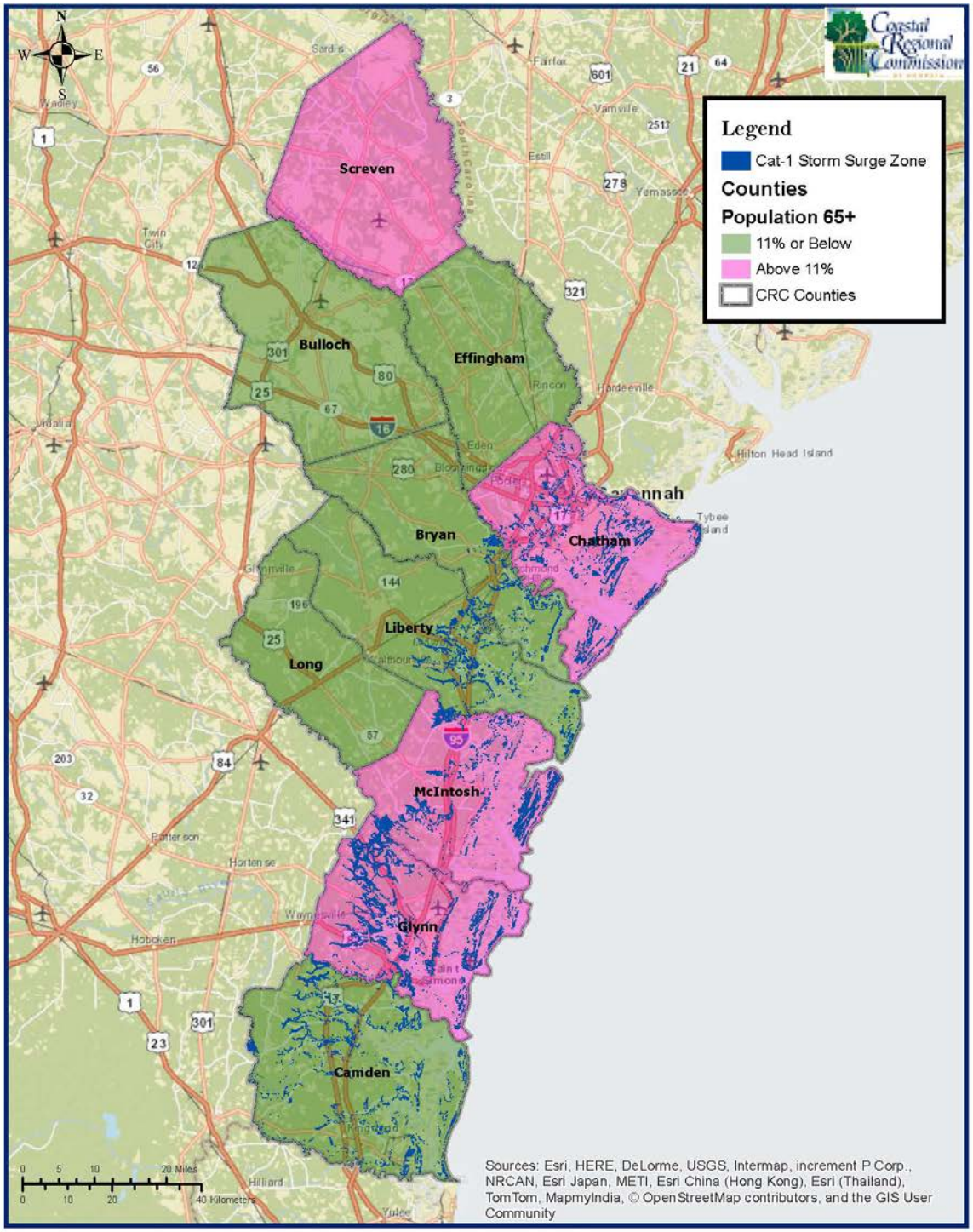
Projected County Population Growth Compared to 32% Regional Average, 2010-2030

June 2015



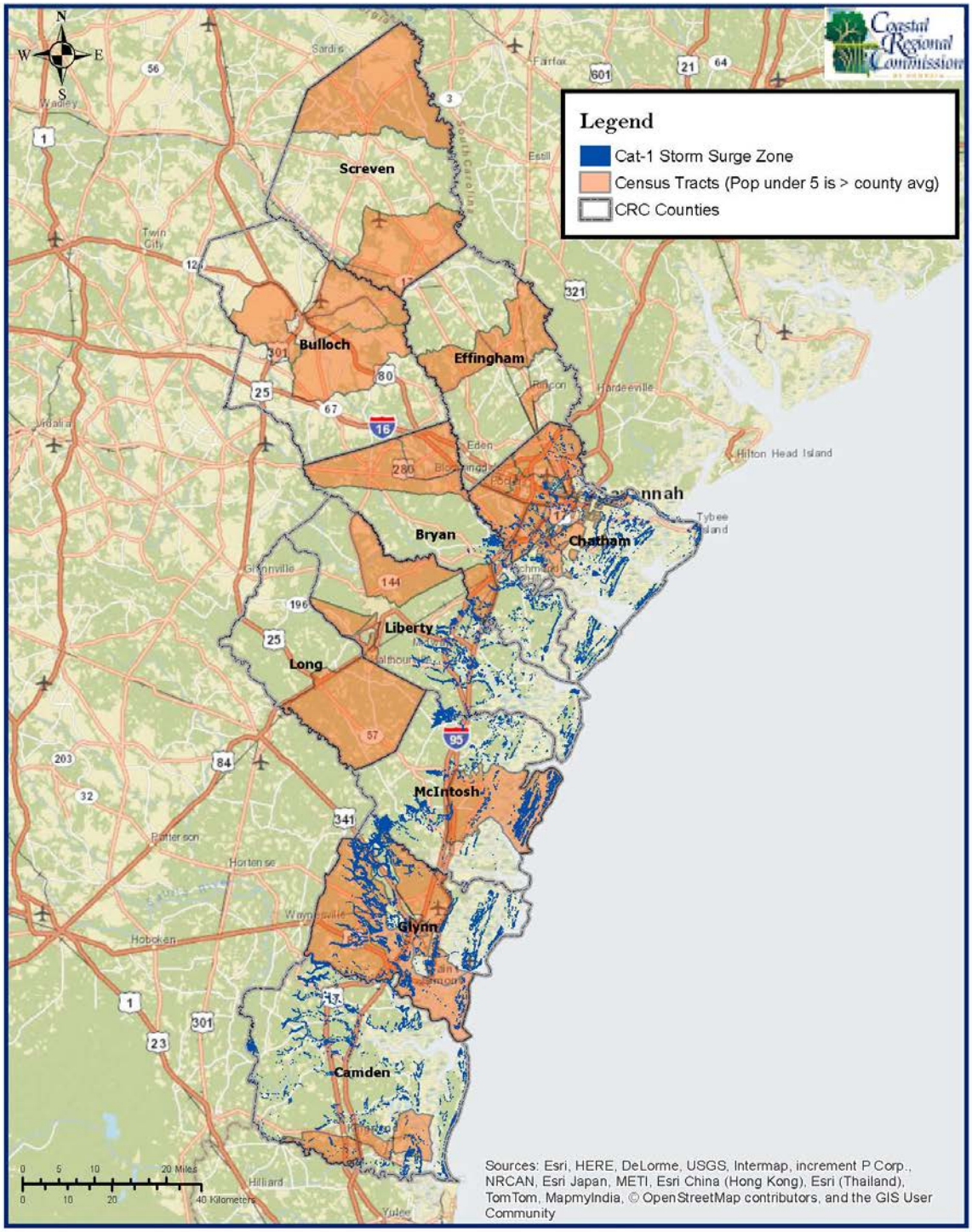
County Population Under 5 Compared to 8% Regional Average, 2010

June 2015



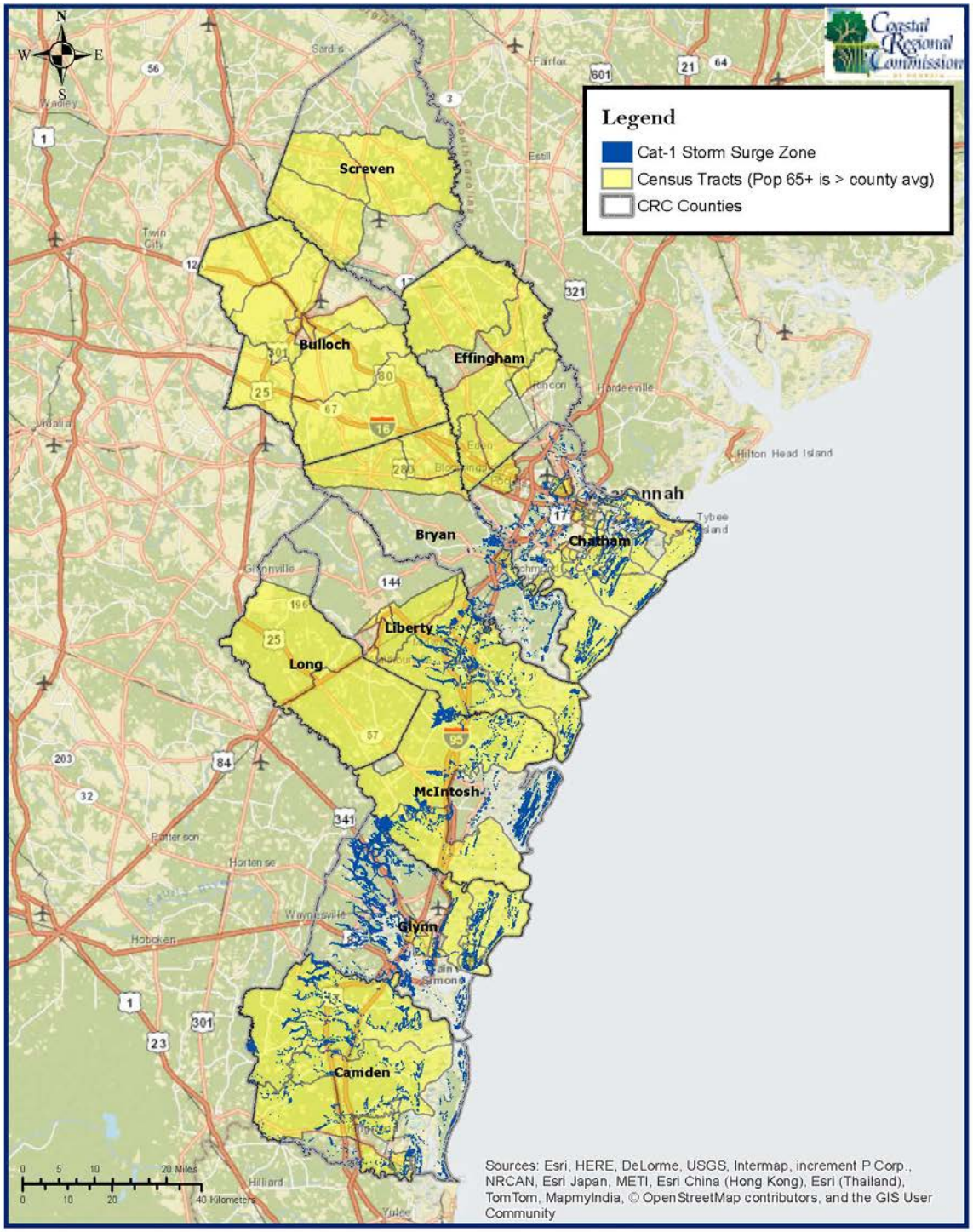
County Population Aged 65+ to 11% Regional Average, 2010

June 2015



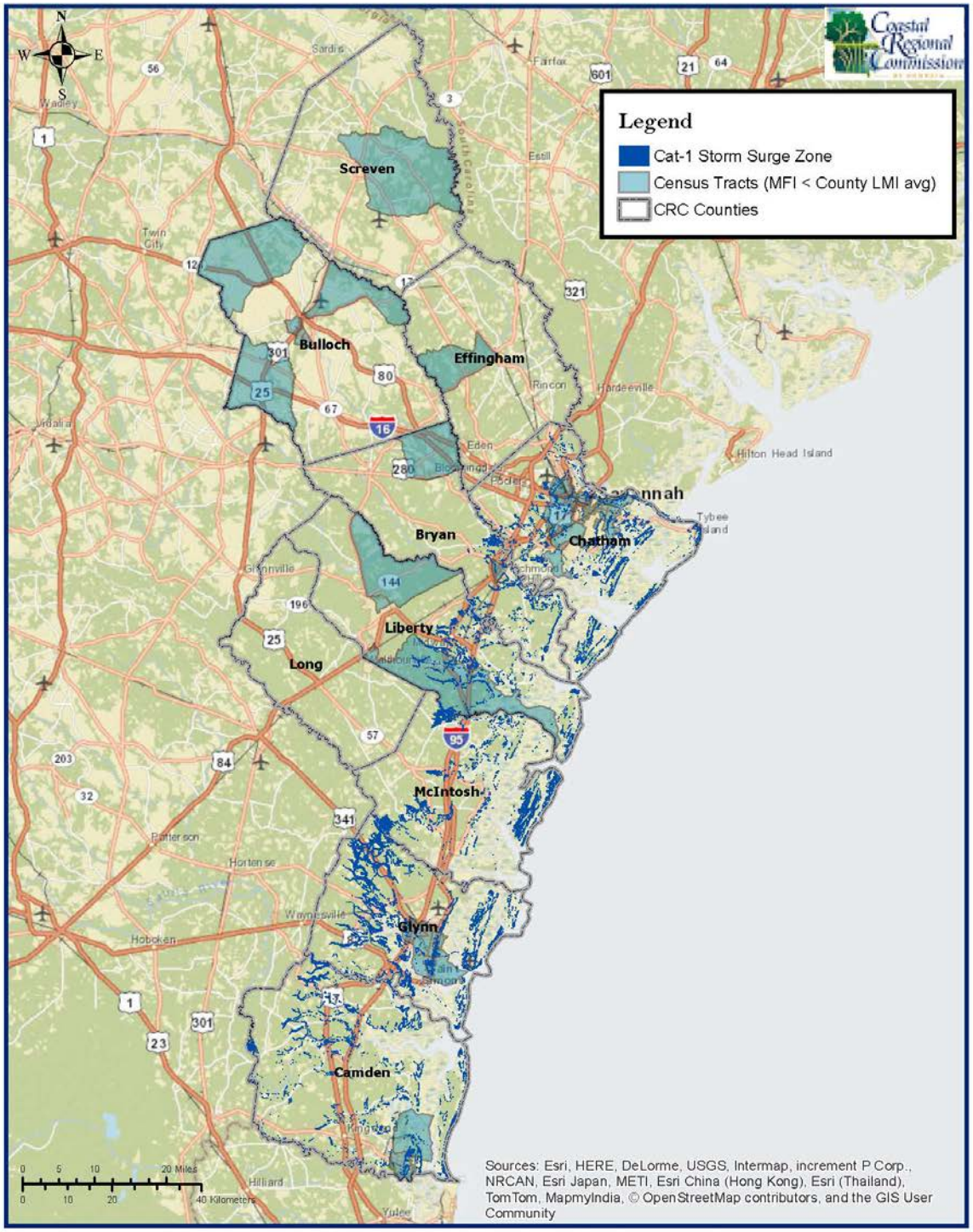
Census Tracts Where Population Aged Under 5 is Above County's Average

June 2015

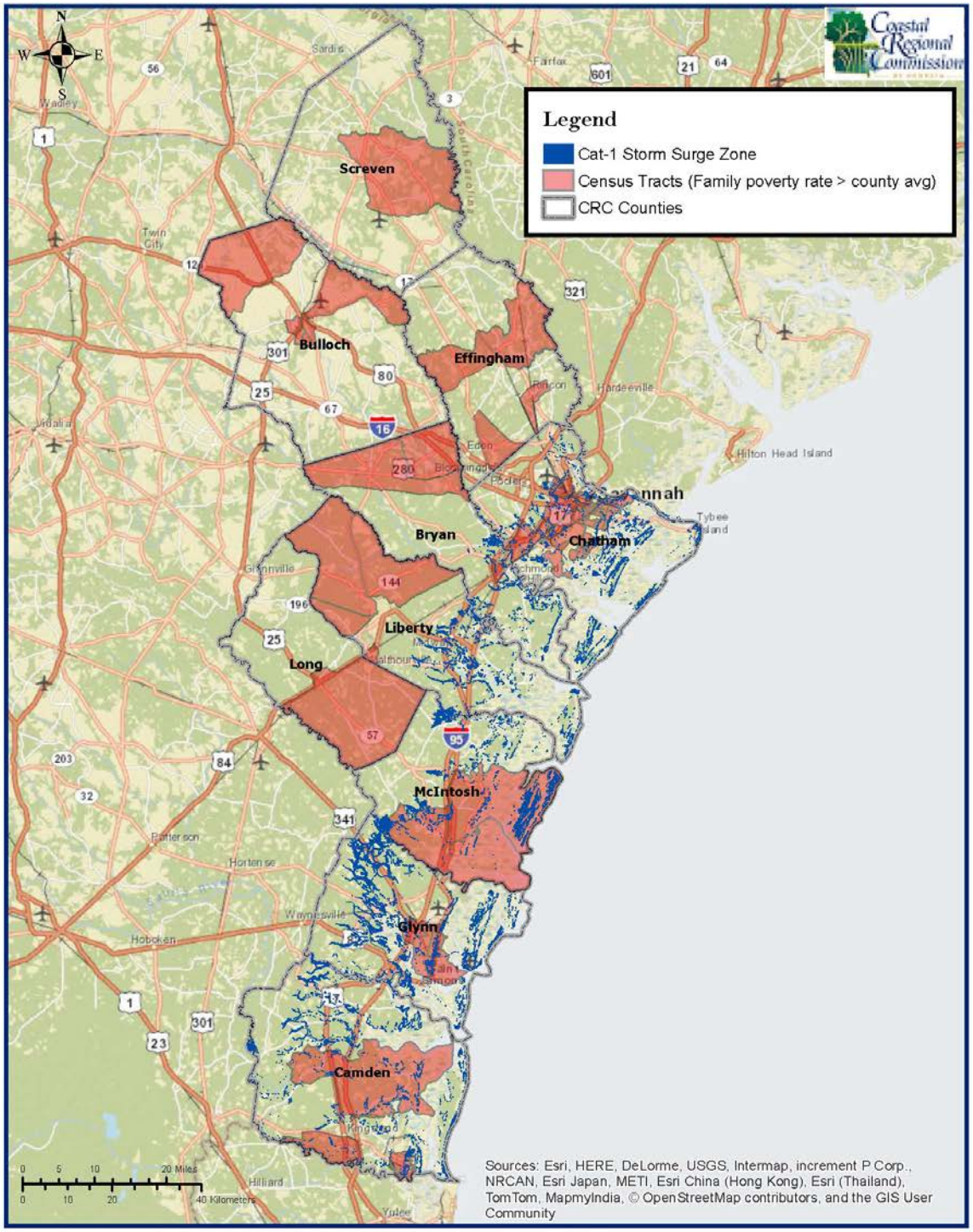


Census Tracts Where Population Aged 65+ is Above County's Average

June 2015

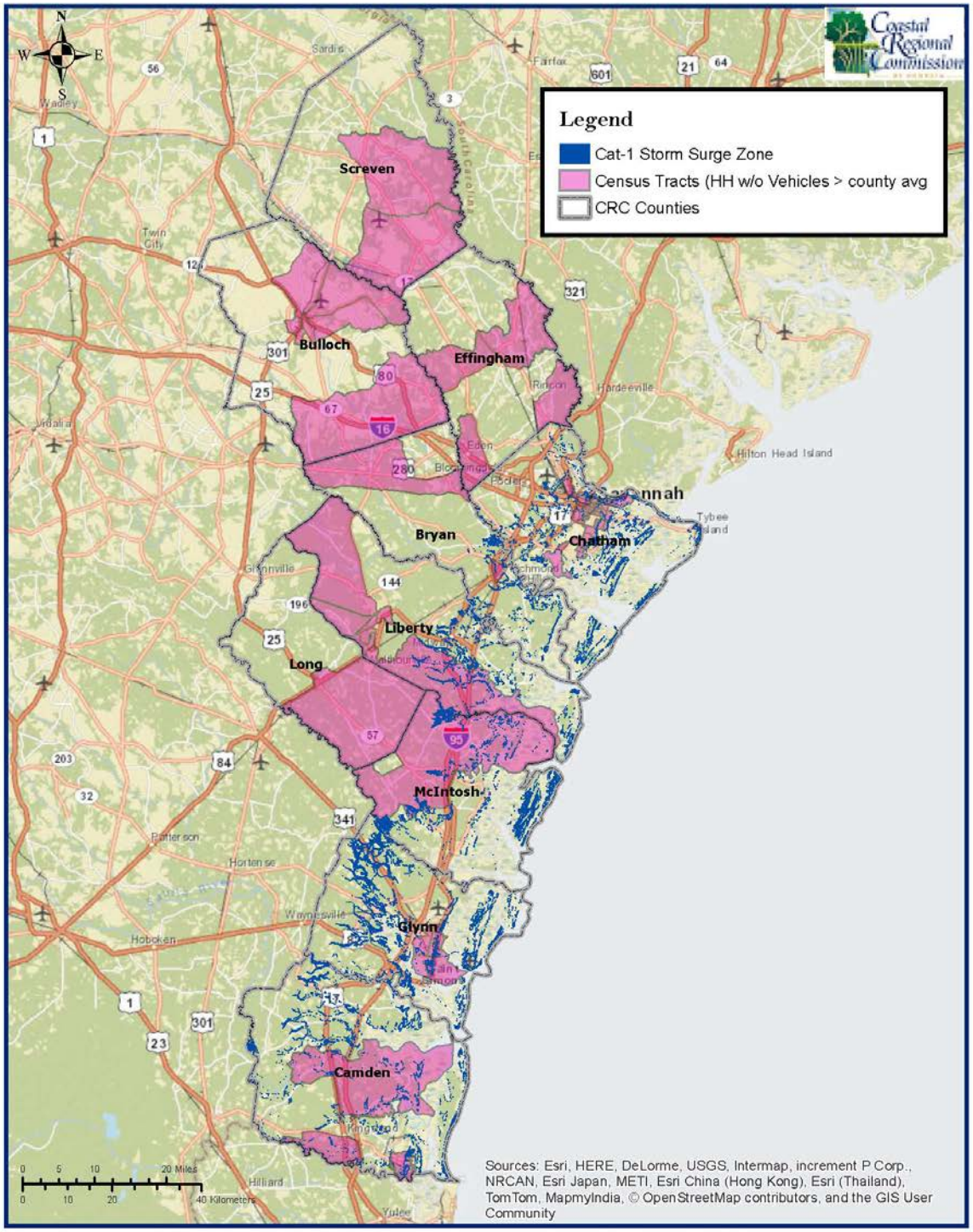


Census Tracts Where Median Family Income Rate is Below County's Average Low/Mod Income Level June 2015

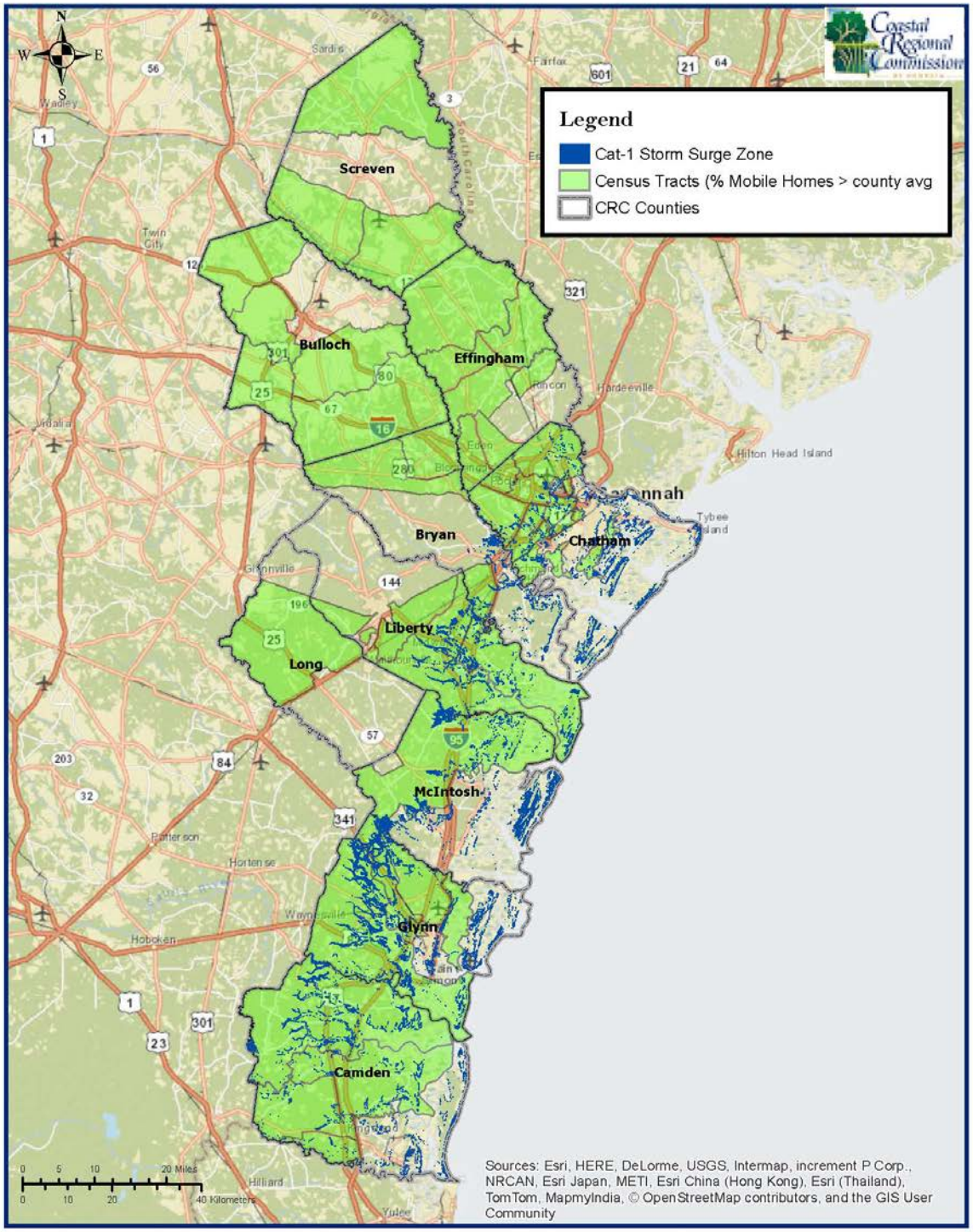


Census Tracts Where Family Poverty Rate is Above County's Average

June 2015



Census Tracts Where Percentage of Households Without Vehicles is Above County's Average June 2015



Census Tracts Where Percentage of Mobile Homes is Above County's Average

June 2015

Regional Growth Trends

Coastal Counties Percent Change in Population 1980 - 2030								
County	**1980-1990**	**1990-2000**	**2000-2005**	**2005-2010**	**2010-2015**	**2015-2020**	**2020-2025**	**2025-2030**
Bryan	52%	52%	22%	6%	11%	20%	31%	13%
Bulloch	21%	30%	10%	14%	11%	11%	13%	11%
Camden	126%	45%	5%	10%	13%	-7%	58%	16%
Chatham	7%	7%	3%	11%	8%	7%	0%	5%
Effingham	40%	46%	25%	11%	11%	11%	49%	17%
Glynn	14%	8%	6%	11%	6%	6%	14%	8%
Liberty	40%	17%	-7%	14%	7%	8%	14%	9%
Long	46%	66%	8%	31%	17%	16%	-19%	9%
McIntosh	7%	26%	2%	29%	8%	7%	10%	13%
Screven	-1%	11%	0%	-5%	1%	0%	29%	5%
Region	19%	17%	5%	12%	9%	7%	15%	10%

Adapted from Coastal Georgia RDC Regional Plan Update 2004 to include six coastal counties.

Coastal Counties Population Growth 1980 - 2030									
County	**1980**	**1990**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Bryan	10,175	15,438	23,417	28,549	30,233	33,510	40,097	52,466	59,534
Bulloch	35,785	43,125	55,983	61,454	70,217	78,019	86,985	98,387	109,034
Camden	13,371	30,167	43,664	45,759	50,513	56,836	52,935	83,431	96,743
Chatham	202,226	216,935	232,048	238,410	265,128	285,022	306,088	307,506	324,098
Effingham	18,327	25,687	37,535	46,924	52,250	58,232	64,553	96,094	112,062
Glynn	54,981	62,496	67,568	71,874	79,626	84,632	89,307	101,441	109,771
Liberty	37,583	52,745	61,610	57,544	65,327	70,032	75,540	86,448	93,821
Long	4,254	6,202	10,304	11,083	14464	16,861	19,498	15,744	17,171
McIntosh	8,046	8,634	10,847	11,068	14,333	15,525	16,644	18,375	20,686
Screven	14,043	13,842	15,374	15,430	14,593	14,773	14,809	19,036	20,036
Region	398,791	475,271	558,350	588,095	656,684	713,442	766,456	878,928	962,956

Business Vulnerability

Using Nielsen business facts point data in conjunction with storm surge data provides a picture of what damage can be expected from various types of storms on coastal counties. This data provided the geo position for every business as well as an estimated number of employees and sales. This data is then combined with storm surge data to best understand the immediate impact of the various types of catastrophic events.

Storm Type	Businesses Effected	% Total Regional Businesses	Jobs Effected	% Total Regional Jobs	Sales Effected $	% of Regional Sales Effected
Tropical Storm	665	2%	5,388	2%	1,542,195,000	3%
Category 1	2,323	8%	23,270	8%	3,796,970,000	7%
Category 2	8,435	29%	84,079	28%	17,498,820,000	32%
Category 3	16,135	56%	158,000	53%	33,881,203,000	61%
Category 4	21,453	75%	205,758	69%	46,208,863,000	83%
Category 5	22,667	79%	229,344	77%	48,539,801,000	88%

Economic Damage by Hurricane Surge for Coastal Georgia. Information provided by Claritas Nielsen (2013). Business Facts 2013. Part 1 [Data file]. NOAA and FEMA

Infrastructure

Infrastructure and Critical Facilities

The guidelines presented in Task 5 of the FEMA Hazard Mitigation Handbook were followed to assess the infrastructure of the following six Coastal Counties: Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden County. According to FEMA guidelines, the most critical infrastructure systems and facilities to evaluate for mitigation opportunities include transportation, communication, power water and wastewater, and emergency services.

County data for many of these types of infrastructure is unavailable, so the focus of the assessment is transportation, emergency evacuations routes, and communication networks. Throughout the assessment process, an evaluation on the dependencies between infrastructure systems, critical facilities, and the populations they serve was conducted. Proposals for effective mitigation strategies are general and serve as guidelines, which can be tailored for specific applications which conform to the county's need.

The following chart from the FEMA Hazard Mitigation Handbook summarizes these critical areas:

Example — Infrastructure and Critical Facilities

Critical Facilities	High Potential Loss Facilities	Infrastructure Systems
Hospitals and medical facilities	Nuclear power plants	Water and wastewater
Police and fire stations	Dams	Power utilities
Emergency operations centers	Military and civil defense installations	Transportation (roads, railways, waterways)
Evacuation shelters	Locations housing hazardous materials	Communication systems/centers
Schools		Energy pipelines and storage
Airports/heliports		

FEMA Hazard Mitigation Handbook, page 57

Methodology

Data was collected from the following sources: FEMA, GEMA, NOAA, Georgia Department of Transportation, Dewberry Consulting, CRC, and the six coastal counties.

Informational maps were created in ArcGIS by the overlaying of different types of infrastructure with storm surge and population data. This method allowed for the quick identification of areas of higher risk in the event of a tropical storm or hurricane.

An assessment of the vulnerability of infrastructure systems for each county by hurricane category was conducted. In order to create an assessment, FEMA guidelines and CRC documents were examined; criteria were formed based on this structure.

Infrastructure was divided into three main categories: transportation, communication, and critical facilities. The categories were further divided into subcategories.

A number of infrastructure items affected by hurricane category were calculated.

For single item infrastructure, such as cell towers and bridges, a count of each item was conducted. For infrastructure such as roads and railroads, mileage per hurricane category was conducted. These calculations, along with the GIS analysis, allowed for identification of

areas within each county whose infrastructure is more vulnerable to storm surge and flooding. From this information 3 Scenarios were created.

After quantifying data in GIS, a chart was created to illustrate how numbers demonstrate a pattern reflective of the overall vulnerability of each county in terms of their infrastructure systems. This chart is divided into three scenarios, each representing the different hurricane category.

- Scenario 1 represents a tropical storm, which is its own category, since this storm is most likely to occur and cause excessive flooding.
- Scenario 2 represents hurricane Categories 1 and 2, which reflects a remarkable increase in potential inundation; and
- Scenario 3 represents hurricane Categories 3, 4, and 5 which reflects the catastrophic inundation caused by a major storm.

In order to visually display the change in impact from one scenario to another, a rating of *high, medium, or low* is assigned to each feature. These ratings were based on a total percentage of 100 divided into three equal parts. A "low" rating shows that less than 33 percent of an infrastructure type would be affected, "medium" shows that less than 67 percent would be affected, and the "high" rating means that over 67 percent of the infrastructure would be potentially inundated. If the range between hurricane categories resulted in two different ratings, the higher rating was applied.

The initial vulnerability assessment of infrastructure for each county identifies a number of infrastructure types per county affected by tropical storms up to a Category 5 hurricane. Critical areas were based on categories from Task 5 in the FEMA document. The counties with the highest number reflect highly vulnerable areas that should be noted as "Critical Areas." Major roads, bridges communication tower and water facilities are most important in terms of resilience as they serve the core daily needs of the population. Based on the assessment charts below, Chatham, Glynn, and Camden counties have the highest number of infrastructure features, and have the largest amount of critical infrastructure that would be affected by a storm.

Each of these counties also contain inhabited barrier islands which play a crucial role in protecting the mainland, but are becoming more susceptible to damage as urban development increases. Such areas are especially susceptible during large storms. Flash flooding may inundate important transportation routes, or block emergency evacuations. For example, each of these barrier islands, Tybee, Saint Simons, and Jekyll are at sea level or a few feet above and have a single road leading off the island. During an evacuation, road inundation causes major problems. Adequate planning is needed to insure transportation routes can be integrated with existing routes. From this initial assessment a second chart was created to reflect the overall vulnerability of each county's infrastructure, and determine any patterns.

An initial table was created to show the vulnerability assessment of critical infrastructure systems in each county. Some counties did not have public data available for certain types of infrastructure, which is noted with "N/A." The totals reflect the levels of vulnerability of counties and their infrastructure networks to the effects of storm surge. McIntosh County has no emergency evacuation route data, which means that their hazard mitigation plans need to be updated or McIntosh County needs to develop appropriate evacuation routes that can be integrated with existing routes.

The tables below reemphasize the vulnerability of each county with the three different scenarios. Chatham, Glynn, and Camden County mitigating infrastructure networks in these areas should be a priority in a regional resiliency plan. Data was gathered from NOAA, the Georgia Department of Transportation, FEMA, GEMA, and each individual county website. Based on sets of data, it is determined that transportation is a top concern in all six counties. Transportation routes, such as U.S. Highway 17, connect hubs to one another, and critical areas along major arterials must be highlighted. The threat of flooding throughout the region is of concern, especially along U.S. Highway 17, where bridges and roads are near sea level elevation. Another major concern are the condition and location of evacuation routes. The infrastructure connected to these routes should be reevaluated by each county to ensure that the age and condition of major arterials and bridges meets quality performance standard. Traffic counts and populations in these areas are especially

important when developing mitigation strategies and prioritizing infrastructure based on quality and use.

Transportation infrastructure is especially important in the port cities of Savannah and Brunswick. As one of the busiest ports in North America, the port of Savannah requires an intricate network of infrastructure to support and maintain its services; thus, these two cities will always have a higher vulnerability rating. The failure of port services, due to the failure of transportation routes, will have detrimental effects on the economy.

The results of Scenario 1 (Tropical Storm) are shown in the table below. Though the vulnerability rating seems low, it is important to remember that flooding still occurs and a "low" rating does not mean there no damage, only that the storm surge levels and threat for inundation is lower. However, the most critical infrastructure for a certain county may be inundated, even with this low rating. It is a county or city decision to assess which of their structures, especially along the coastline, should receive priority in mitigation strategies. The location, usage, and condition of the structure needs consideration when assessing their priority. The recommendation section of this report describes the process of creating a "priority" list in more detail. Since this scenario involves mostly flood damage possibilities, high attention should be paid to storm water management mitigation to keep roads, houses and business from being flooded. Flood gates, such as those in Tybee Island, are a possible solution to managing flood water in a coastal community. Effectively managing flood water subsequently protects most other forms of critical infrastructure.

Scenario 1: Tropical Storm											
County	Critical Infrastructure										Overall Vulnerability Rating
	Communincation		Transportation				Ports*	Water Facilities*	Waste Facilities*	Power Stations*	
	Cell Towers*	Antenna Towers*	Roads**	Railroads**	Bridges*	Evacuation Routes**					
Chatham	2/12	8/127	139.4 /1778.1	16.43/179.5	60/265	1.11/79.9	1/1	1/8	N/A	N/A	9
Bryan	0/8	0/31	21 /528.4	1.33/38.7	8/88	0.15/64.6	N/A	N/A	N/A	N/A	6
Liberty	0/5	0/40	69.8 /1238.6	1.64/42.3	25/75	0.24/56.5	N/A	N/A	N/A	N/A	7
McIntosh	0/5	0/18	149.3 /961.5	0/18.5	26/71	N/A	N/A	N/A	N/A	N/A	10
Glynn	0/8	15/63	130.8 /855.4	3.06/88.4	30/90	0.25/50	1/1	N/A	N/A	N/A	10
Camden	1/10	2/39	106.1 /763.6	5.8/54.7	44/133	0.31/24.47	N/A	N/A	N/A	N/A	7
Total	**48**	**318**	**6125.5 mi**	**421.8 mi**	**724**	275. 5	2	N/A	N/A	N/A	
LEGEND	Low	Medium	High		* Calculated by count ** Calculated in miles			*Sources: NOAA, GDOT, FEMA, GEMA, Individual County Data & Documents*			

Scenario 2 (Category 1 & 2 Hurricanes) shows the increase in risk in the affected area from a tropical storm shown in Scenario 1. These are hurricane categories that may not seem as threatening as larger storms, but in fact cause potential damage due to storm surge and aggressive flooding. Glynn and McIntosh counties have high vulnerability ratings, since the majority of their critical infrastructure may be affected. Chatham and Camden Counties have medium ratings, but could be considered high-risk since most of the population lives near a river or the ocean. Each of these counties also have inhabited barrier islands which should be marked as highly vulnerable areas due to their limited access to the mainland. Though Liberty and Bryan Counties still show a "low" rating, they are vulnerable, as they serve as connection hubs between the northern and southern parts of the region, especially connecting the highest populated port cities of Savannah and Brunswick.

Scenario 2: Category 1 & 2 Hurricane											
County	Critical Infrastructure										Overall Vulnerability Rating
	Communincation		Transportation				Ports*	Water Facilities*	Waste Facilities*	Power Station*	
	Cell Towers*	Antenna Towers*	Roads**	Railroads**	Bridges*	Evacuation Routes**					
Chatham	7-9/12	14-38/127	295.5-695.15 /1778.1	24.85-71.28/179.5	69-114/265	2.71-14.07/79.9	1/1	N/A	N/A	N/A	13
Bryan	0-1/8	1-12/31	50.8-171.9 /528.4	1.63-7.55/38.7	12-17/88	0.98-7.80/64.6	N/A	N/A	N/A	N/A	7
Liberty	0/5	1-9/40	105.8-273.6 /1238.6	2.67-10.38/42.1	29-45/75	1.11-6.53/56.5	N/A	N/A	N/A	N/A	7
McIntosh	0/5	3/18	224.8-539.3 /961.5	0.78-6.58/18.5	49/71	N/A	N/A	N/A	N/A	N/A	13
Glynn	4/8	46/63	280.3-611.5 /855.4	13.86-55.47/88.4	54/90	2.38-17.93/50	1/1	N/A	N/A	N/A	17
Camden	3/10	10/39	165.7-371.9 /763.6	5.85-18.95/54.7	85/133	0.80-2.63/24.47	N/A	N/A	N/A	N/A	10
Total	**48**	**318**	**6125.5 mi**	**421.8 mi**	**724**	275.5	2	N/A	N/A	N/A	
LEGEND	Low	Medium	High		* Calculated by count ** Calculated in miles			*Sources: NOAA, GDOT, FEMA, GEMA, Individual County Data & Documents*			

Scenario 3 (Category 3, 4, & 5 Hurricanes) reflects the highest threat to the coastal region. In this scenario, the majority of counties are at high risk. In a Category 3 hurricane, the majority of the coastal population and urban development areas are affected. Though this scenario seems less likely than the others, it should be planned for and considered when updating existing infrastructure systems or building new ones. Planning for the highest level threat is an efficient mitigation strategy that increases overall resilience of this region.

Scenario 3: Category 3, 4, & 5 Hurricane											
County	Critical Infrastructure										Overall Vulnerability Rating
	Communincation		Transportation				Ports*	Water Facilities*	Waste Facilities*	Power Stations*	
	Cell Towers*	Antenna Towers*	Roads**	Railroads**	Bridges*	Evacuation Routes**					
Chatham	11-12/12	90-119/127	1236.5-1634.2 /1778.1	132.35 170.48/179.4	172-250/265	37.45-72.19/79.9	1/1	N/A	N/A	N/A	21
Bryan	3/8	16/31	227.8-240.4 /528.4	14.08-18.04/38.7	36-52/88	20.44-26.93/64.58	N/A	N/A	N/A	N/A	12
Liberty	4/5	19-24/40	520-636.2 /1238.6	22.04-28.50/42.1	54-58/75	13.25-23.96/56.5	N/A	N/A	N/A	N/A	14
McIntosh	3/5	11-14/18	810.4-915.95 /961.5	17.3-18.5/18.5	65-69/71	N/A	N/A	N/A	N/A	N/A	17
Glynn	8/8	60-63/63	751.9-822 /855.4	82.1-87.28/88.4	72-76/90	40.58-47.68/50	1/1	N/A	N/A	N/A	18
Camden	3-10/10	20-37/39	545.7-716.4 /763.6	38.73-51.49/54.7	103-129/133	9.34-22.1/24.5	N/A	N/A	N/A	N/A	18
Total	**48**	**318**	**6125.5 mi**	**421.8 mi**	**724**	275. 5	2	N/A	N/A	N/A	
LEGEND	Low	Medium	High		* Calculated by count ** Calculated in miles			*Sources: NOAA, GDOT, FEMA, GEMA, Individual County Data & Documents*			

Built Environment

Community Agendas represent the most important part of local governments Comprehensive Plans as it presents the community's vision for the future and key issues and opportunities that communities choose to address along with the implementation program. The Community Agenda updates the material in the Community Assessment based on public input and includes a vison, a short and long term work program and list of policies for decision making.

Methodology

1) Review/Inventory of current hazard mitigation plans, comprehensive plans, and community agendas at a city and county scale.
2) Identify gaps within each plan
   - What year was the document created?
   - Number of pages in document? (Provide a sense of the thoroughness of each document)
   - Make an inventory of "key words" throughout document.
3) Create a ranking system based upon above criteria for each county and city.
4) Display all information on an easy to read chart.

Evaluation of Current Policies, Activities, and Development Patterns

Comprehensive Plans, Community Agendas and Hazard Mitigation Plans

Though individual city plans were assessed, the results are examined on a county scale. McIntosh County scores the highest on the assessment of the County Comprehensive Plans and Community Agendas. Liberty scores the second highest followed by Chatham, Glynn, Camden, and finally Bryan county. The three counties with updated Hazard Mitigation Plans receive the same overall ranking.

There are common gaps in the County Comprehensive Plans, Community Agendas, and Hazard Mitigation Plans. The majority of the County Comprehensive Plans and Community Agendas lack specificity when addressing concerns related to infill development, the presence of aquifers and/or reservoirs, and shoreline, riparian and estuary protection.

In the three available hazard mitigation plans there is little or no mention of aquifers or reservoirs. Furthermore, major issues related to protecting vulnerable areas from potential hazards are ignored. In all three of the available Hazard Mitigation Plans there is a necessity for more detailed plans relating to the protection of estuaries, wetlands, and riparian and coastal zones.

1) Comprehensive plans, community agendas, and hazard mitigation plans: key words were identified for each Comprehensive Plan, Community Agenda and Hazard Mitigation plan, which include:

- Beach
- Dune
- Shore,
- Buffer
- Riparian
- "Estuar"
- Marsh
- Swamp
- Wetland
- Erosion
- "Sediment"
- Soil
- Flood
- Storm
- Aquifer
- Reservoir
- Brownfield
- Grey/Greyfield
- Infill
- Disaster
- Hazard,
- Risk
- Prevention
- Prevention (in relation to crime)
- Protection
- "Mitig"
- "Re-mediat"

All key words listed in quotes are due to variations of the word being present within certain documents. For example, "mitig" would identify every time the words mitigate, mitigates, and mitigation are mentioned. Similar words are grouped together on the, "Review of Community Agendas & Hazard Mitigation Plans," chart. The keyword groupings are as follows:

1. Beach/Dune/Shore
2. Buffer
3. Riparian/Estuaries
4. Marsh/Swamp/Wetland
5. Erosion/Sediment/Soil
6. Flood/Storm
7. Aquifer/Reservoir
8. Brownfield/Greyfield /Infill
9. Disaster/Hazard/Risk
10. Prevention
11. Protection
12. Mitigation/Remediation
13. Overall Ranking

With the above findings, two different assessments were completed:

A) Color Coding:

Color code ranks the documents based on how well the identified issues were addressed in various documents adopted by counties for community improvement. The analysis scanned documents for key words and determined how well these issues were addressed.

B) Numerical Ranking:

After assessing the details and evaluating the various documents for the issues identified, a numerical ranking was assigned (ranging from 0-3) to each issue depending on how well the topic was addressed by the counties. The map below shows the diagrammatic representation of this ranking system. Red symbolizes that the issue needs critical attention in the planning document; yellow symbolizes that the issue has been addressed but still needs improvement in some parts, and green symbolizes that the issue has been well addressed. Ranking zero represents missing information or is an irrelevant issue. On the basis of the ranking provided to each issue, an overall ranking was calculated for each county which is shown in the last column of the table. A similar assessment with the same criteria was done for the hazard mitigation plans for all the counties which is shown in table.

County	City	Year	Pages in Document	Beach	Dune	Shore	Buffer	Riparian	"Estuar"	Marsh
	Community Agendas/Comprehensive									
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	Last 41 of 140	0	0	0	9	0	0	1
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	First 99 of 140	0	0	0	18	0	0	3
Camden	Camden- Joint Comprehensive Plan	Oct- 2008	150	2	0	2	13	0	0	29
Chatham	Chatham County/Savannah-Tricentennial Plan	Nov- 2006	149	0	0	4	46	8	13	44
Chatham	Garden City- Community Agenda	Oct- 2008	117	0	0	0	17	1	0	2
Chatham	Port Wentworth- Community Agenda	Oct- 2008	137	0	0	0	4	0	0	5
Chatham	Tybee Island Master Plan-Community Agenda	Jan-2008	169	121	25	0	14	2	0	52
Glynn	Glynn County Comprehensive Plan Update	Oct- 2008	59	11	0	0	5	0	0	13
Glynn	Brunswick- Community Agenda	May-2008	98	3	0	3	1	0	0	33
Liberty	Liberty Community Assessment Consolidated	June-2008	331	0	2	0	18	0	0	36
McIntosh	McIntosh & City of Darien Community Assessment Joint	Oct- 2007	190	8	11	16	3	0	20	71

Table: Evaluation of different documents including Comprehensive Plan and Community Agenda Documents by a color-coding system to understand how and in what depth the individual issues are addressed by individual counties.

County	City	Year	Pages in Document	Swamp	Wetland	Erosion	"Sediment"	Soil	Flood	Storm
	Community Agendas/Comprehensive									
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	Last 41 of 140	1	11	0	0	0	1	7
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	First 99 of 140	0	16	3	2	1	3	6
Camden	Camden- Joint Comprehensive Plan	Oct- 2008	150	1	13	0	0	6	1	10
Chatham	Chatham County/Savannah-Tricentennial Plan	Nov- 2006	149	0	16	4	4	9	18	38
Chatham	Garden City- Community Agenda	Oct- 2008	117	0	6	6	6	2	7	34
Chatham	Port Wentworth- Community Agenda	Oct- 2008	137	4	4	3	3	0	9	30
Chatham	Tybee Island Master Plan-Community Agenda	Jan-2008	169	0	3	4	3	0	5	34
Glynn	Glynn County Comprehensive Plan Update	Oct- 2008	59	0	37	1	0	4	38	26
Glynn	Brunswick- Community Agenda	May-2008	98	0	26	1	0	5	29	40
Liberty	Liberty Community Assessment Consolidated	June-2008	331	0	35	21	16	21	37	17
McIntosh	McIntosh & City of Darien Community Assessment Joint	Oct- 2007	190	18	62	3	4	16	40	21

Table: Evaluation of different documents like Comprehensive Plan and Community Agenda Documents by a color-coding system to understand that how and in what depth the individual issues are addressed by individual counties.

County	City	Year	Aquifer	Reservoir	Brown-field	Grey/Gray-field	Infill	Disaster	Hazard	Risk	Prevention	(in relation to crime)	Protection	"Mitig"	"Remediat"	RANKING
	Community Agendas/Comprehensive															
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	0	0	5	5	8	0	0	0	0	0	36	5	0	1
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	2	0	0	0	8	0	3	1	0	0	99	2	0	1
Camden	Camden- Joint Comprehensive Plan	Oct- 2008	0	0	0	0	37	2	1	0	1	0	129	9	0	1
Chatham	Chatham County/Savannah-Tricentennial Plan	Nov- 2006	4	1	4	4	16	0	4	5	27	2	138	7	0	1
Chatham	Garden City- Community Agenda	Oct- 2008	0	0	3	3	23	1	1	0	4	0	55	4	0	1
Chatham	Port Wentworth- Community Agenda	Oct- 2008	0	0	0	1	29	1	2	0	8	0	50	1	0	1
Chatham	Tybee Island Master Plan-Community Agenda	Jan-2008	3	0	0	0	60	4	1	0	6	0	83	3	0	1
Glynn	Glynn County Comprehensive Plan Update	Oct- 2008	0	0	0	1	19	0	4	0	14	0	29	0	0	1
Glynn	Brunswick- Community Agenda	May-2008	2	0	15	7	0	0	8	8	11	7	57	13	7	1
Liberty	Liberty Community Assessment Consolidated	June-2008	0	0	23	23	69	1	0	9	8	0	251	0	0	2
McIntosh	McIntosh & City of Darien Community Assessment Joint	Oct- 2007	17	0	2	2	18	1	1	0	2	1	142	4	0	2

Evaluation of different documents like Comprehensive Plan and Community Agenda Documents by a color-coding system to understand that how and in what depth the individual issues are addressed by individual counties.

	= Need to address the issue
	= Needs to be addressed further
	= Not necessarily significant
	= Good score
	= A score of zero that is irrelevant because issue is ultimately addressed

Assessment criteria's defining tables

	Year	Number of Pages in Document	Beach	Dune	Shore	Buffer	Riparian	"Estuar"	Marsh	Swamp	Wetland	Erosion	"Sediment"	Soil	Flood
Hazard Mitigation Plan															
Bryan County			0	0	0	0	0	0	0	0	0	0	0	0	0
Camden County	?	185	5	4	3	3	0	1	27	1	10	52	10	3	225
Chatham County	Dec- 2010	240	5	3	3	9	0	0	6	1	7	5	0	2	246
Glynn County			0	0	0	0	0	0	0	0	0	0	0	0	0
Liberty County	2010	120	4	4	4	4	0	0	6	0	10	8	3	4	234
McIntosh County			0	0	0	0	0	0	0	0	0	0	0	0	0

Evaluation of different documents of hazard mitigation plans, by a color-coding system to understand how and in what depth the individual issues are addressed by individual counties.

	Year	Number of Pages in Document	Storm	Aquifer	Reservoir	Brown-field	Grey/Gray-field	Infill	Disaster	Hazard	Risk	Prevention	(in relation to crime)	Protection	"Mitig"	"Remediat"	RANKING
Hazard Mitigation Plan																	
Bryan County			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Camden County	?	185	274	6	0	0	0	0	106	642	74	25	0	95	529	0	1
Chatham County	Dec- 2010	240	236	0	0	0	0	0	513	996	158	19	0	103	997	0	1
Glynn County			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Liberty County	2010	120	175	1	6	0	0	0	44	569	147	20	0	54	608	0	1
McIntosh County			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Evaluation of different documents of hazard mitigation plans by color-coding system to understand how and what depth the individual issues are addressed by individual counties.

	= Need to address the issue
	= Needs to be addressed further
	= Not necessarily significant
	= Good score
	= A score of zero that is irrelevant because issue is ultimately addressed

Assessment criteria's defining table

Building Construction Codes

2) Building construction codes:

Building construction codes were assessed utilizing the criteria from, "Home Builder's Guide to Coastal Construction" document by FEMA based on:

A) Do counties have a well laid-out building construction code for the whole county?

B) Does the construction code comply with the FEMA's builder's guide specifically in terms of:

- Designation of Conservation areas.
- Consideration of Flood Plain Elevation
- Identification of Different Flood Zone
- Relocation\Alteration of Utilities like water lines, gas lines
- Foundation specifications
- Lowest floor level
- Bottom horizontal structure level
- Construction below base flood elevation
- Enclosures below BFE (Base flood elevation)
- Addition and Reconstruction
- Building forms
- Building construction standards and materials

A chart utilizing a color coded system with a color coding of red (not in compliance with FEMA's Document); yellow (discussed but not in detail); and, green (complies with FEMA's Building Code) that specifies the depth to which each county considered the FEMA builder's code. An assessment and overall ranking (from 0-3) was given to each county for efforts incorporating FEMA's standards in their building construction codes.

NOTE: All the assessments were done on the basis of available resources. Low rankings in any category for counties can also be a result of missing or inaccessible data.

	Camden	Bryan	Chatham	Glynn	Liberty	McIntosh
Have a building construction code						
Compliance with FEMA						
1) Designation of conservation areas.						
2) Consideration of Flood Plain Elevation						
3) Identification of Different Flood Zone						
4) Relocation\Alteration of Utilities like Water lines, gas lines						
5) Foundation specifications						
6) Lowest floor level						
7) Bottom horizontal structure level						
8) Construction below base flood elevation						
9) Enclosures below BFE (Base flood elevation)						
10) Addition and Reconstruction						
11) Building form						
12) Construction Standards and material						
Documents Reviewed	**Camden unified development codes**	**Bryan county building code ordinances, Bryan County Engineering Design Standards**	**Flood damage Prevention Ordinance**	**Comply with Flood plain Management in Georgia by Georgia department of Natural Resources**	**liberty county chapter , Building construction and other activities**	**No specific documents available**
No of Pages	**570**	**27, 128**	**23**	**76**	**103**	**0**
Special Notes	-	-		**No specific ordinance found in Glynn County Website, but it seems to comply with GDNR.**	**Compliance with : 1) International Building Codes 2) International Mechanical Code 3) International Gas Codes 4) International Plumbing codes 5) International Electrical Code 6) International Fire prevention Code**	**Couldn't Find any document specifically dealing with or explaining the construction codes.**
RANKING	3	2	3	3	1	1

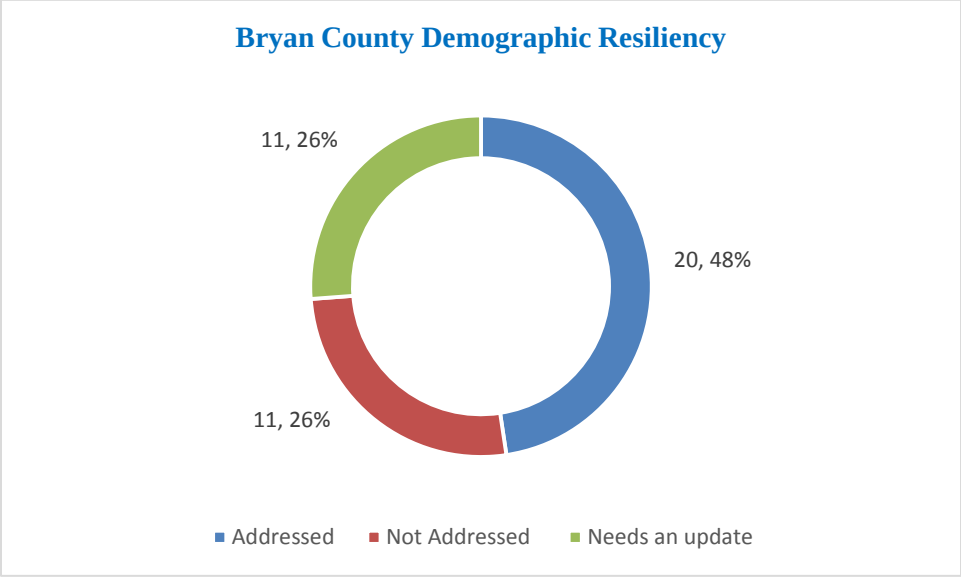
	Not in compliance with FEMA's Document
	Have discussed but not in detail
	Comply with FEMA's Building Code

Chart that refers to different documents relating to building construction codes and compares it with FEMA's guidelines to assess the missing gaps for each county.

Regional Summary Report Resilience

Bryan County Summary

1) **Demographic Resilience**



Note: The total number of issues identifies for demographic resilience are 42

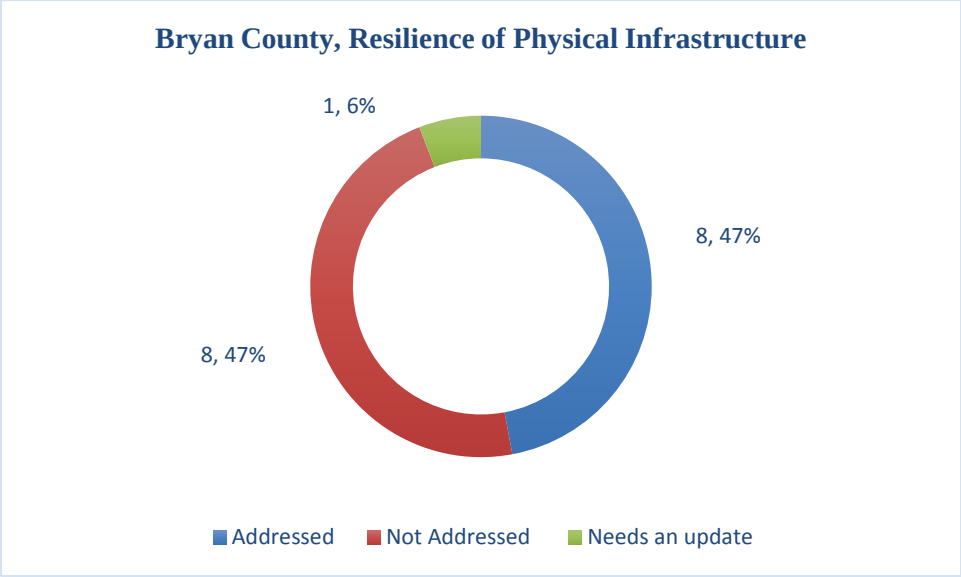
- **Sections of planning document that needs an update are:**
  a) Calculating the boundary of natural disasters
  b) Addressing different population types in the hazard management plan
  c) Considering critical populations (population above the age group of 65 years, and below 5 years of age), and population with chronic diseases.
  d) Considering special needs, and evacuation plans required for the critical population, population with chronic disease.
  e) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)
- **Missing sections of planning documents:**
  a) Emergency medical center's locations for both general public, and critical population
  b) Animal rescue centers.
  c) Mapping the major concentration (hot-spot) of economic center
  d) Relocation plans for critical infrastructure in the natural hazard zone.

e) Special arrangements like, early evacuation facility, food supply, medical care, etc. for critical section of population.

f) Special insurance program for the critical section of population during the recovery process

g) Special education and outreach program for the critical section of population.

2) Resilience of Physical Infrastructure:

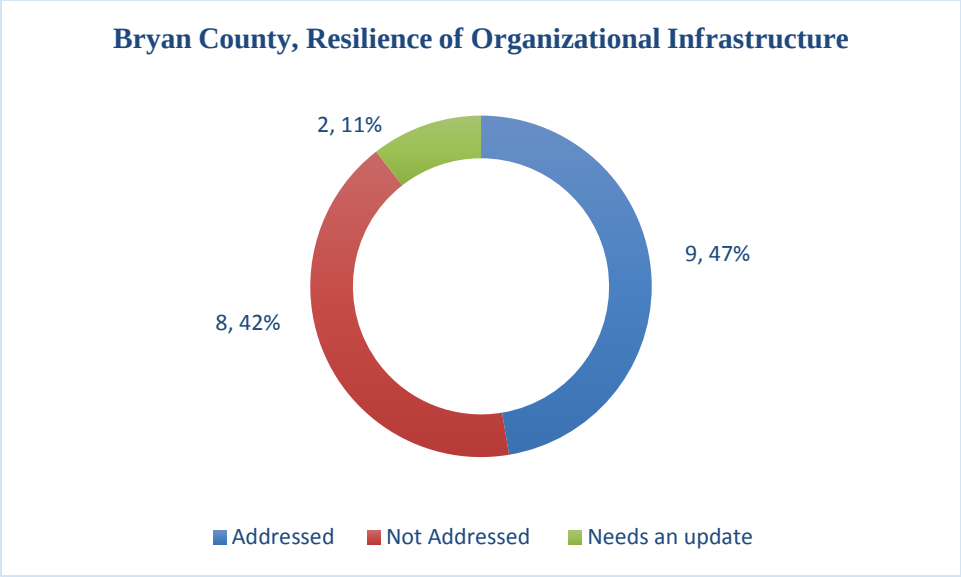


Note: The total number of issues identifies for resiliency of physical infrastructure are 17

- **Sections of planning document that needs an update are:**
  a) Understand the type of impacts caused by different forms of (Solid, liquid, or gas) natural event.
- **Missing sections of planning documents:**
  a) Validating the identified critical infrastructure identified for the city with the standard list of documents provided by Federal or national agencies.
  b) Calculating social, and economical impact of disturbance in functioning of few major infrastructure like, electricity, water, food supply, and road conditions.
  c) Map the identified critical infrastructure in hazard zone, to understand the potential damage.
  d) Evaluate the physical condition of critical infrastructure
  e) Relocation policy for critical infrastructures
  f) Programs for alternate way of communication during the recovery period

g) Special health care facility for the population group associated with the critical infrastructure

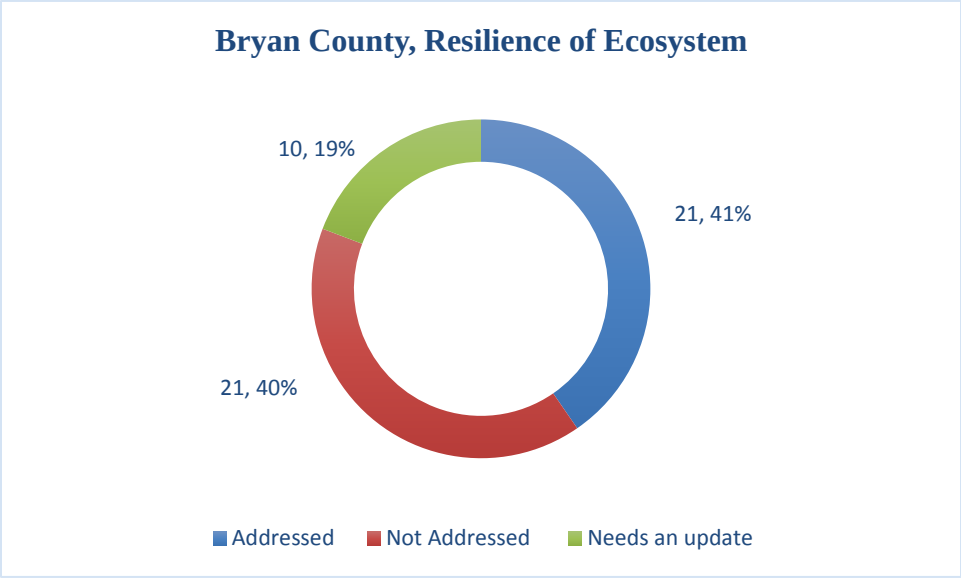
3) **Resilience of Organizational Infrastructure:**



Note: The total number of issues identifies for resiliency of organizational infrastructure is 19

- **Sections of planning document that needs an update are:**
  a) Policies for post-disaster child care facility
  b) Emergency communication facility at the time for disaster
- **Missing sections of planning documents:**
  a) Partnership with the response team to assist during the disaster
  b) Disaster management program
  c) Awareness, supply management, and public outreach programs
  d) Temporary shelter, and health care facility for the local population during the disaster
  e) Post-disaster cleanup program
  f) Post disaster recovery plan

4) **Resiliency of Ecosystem:**



Note: The total number of issues identifies for resiliency of ecosystem is 52.

- **Sections of planning document that needs an update are:**
  a) Air quality index for the counties
  b) Data on energy, and oil consumption
  c) Urban growth rate of the cities/ county
- **Missing sections of planning documents:**
  a) Description of existing land cover
  b) Ground water quality
  c) Total urban, and rural population
  d) Geomorphological study of the area
  e) Measuring the change in natural buffer
  f) Shore line protection policies (if valid)
  g) Consideration for green power/ clean power production, and usage
  h) Measuring the increase in heat island effect in the area

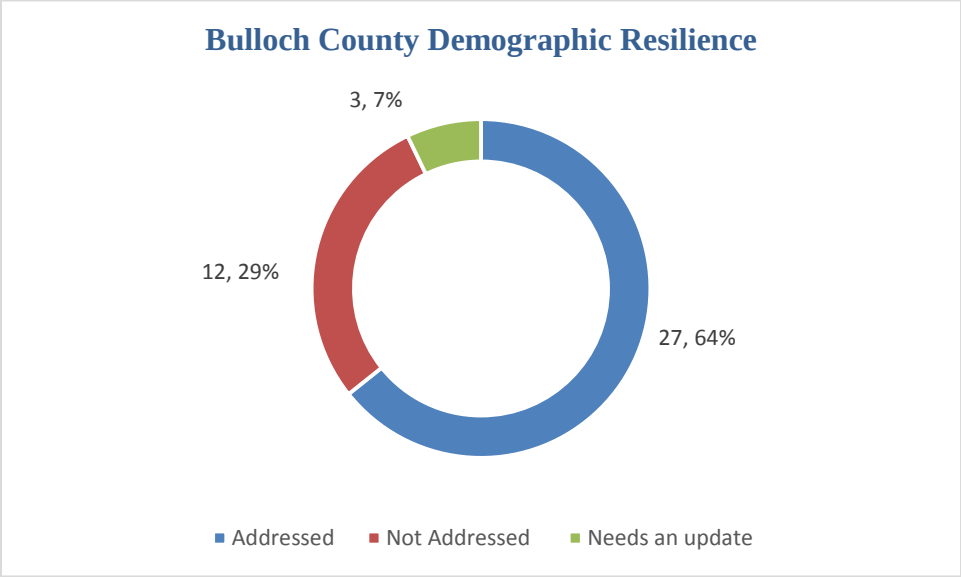
The final resilience score of the Bryan County (based on the available documents for review) is:

- Total number of issues: 130
- Addressed: 58 (1 point each) = 58 points
- Needs update: 24 (0.5 points each) = 12 points

Resilience score of Bryan county, GA = 70 points

Bulloch County Summary

1) Demographic Resilience



Note: The total number of issues identifies for demographic resilience are 42

- **Sections of planning document that needs an update are:**

  a) Location of county with respect to the proximity to natural disaster

  b) Types of natural event occurring in the study area

  c) Calculating the estimate loss by natural event by calculating the property value in the hazard zone

  d) Considering special needs, and evacuation plans required for the critical population, population with chronic disease.

- **Missing sections of planning documents:**

  a) Calculating the boundary of natural disasters

  b) Percentage of city under the estimated boundary of natural event

  c) Percentage of population under the estimated hazard zone

  d) Percentage of critical group pf population (population above age group of 65 years, or below 5 years of age group, along with the people suffering from chronic disease) under natural hazard zone

  e) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)

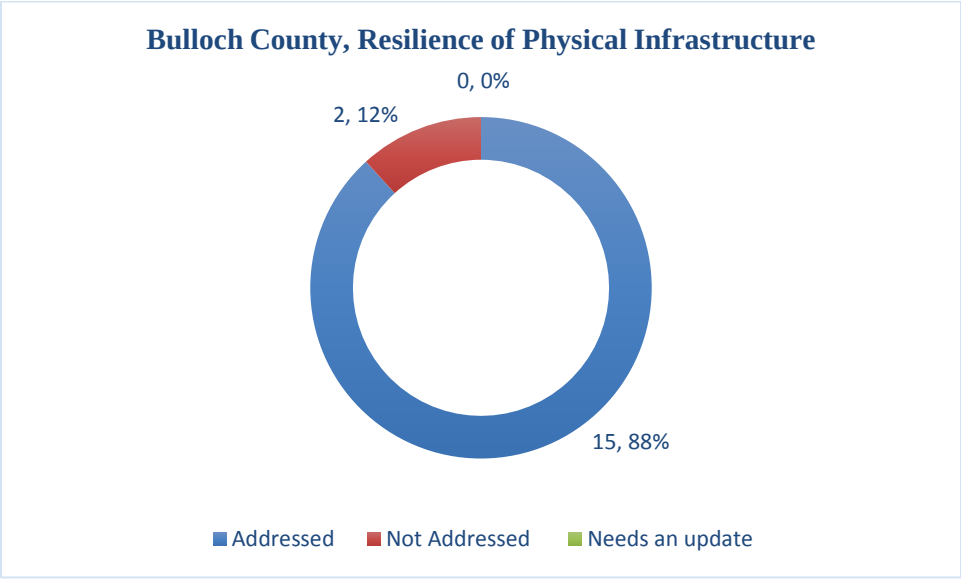
f) Mapping the major concentration (hot-spot) of economic center

g) Special arrangements like, early evacuation facility, food supply, medical care, etc. for critical section of population.

h) Special insurance program for the critical section of population during the recovery process

i) Special education and outreach program for the critical section of population

2) Resilience of Physical infrastructure:



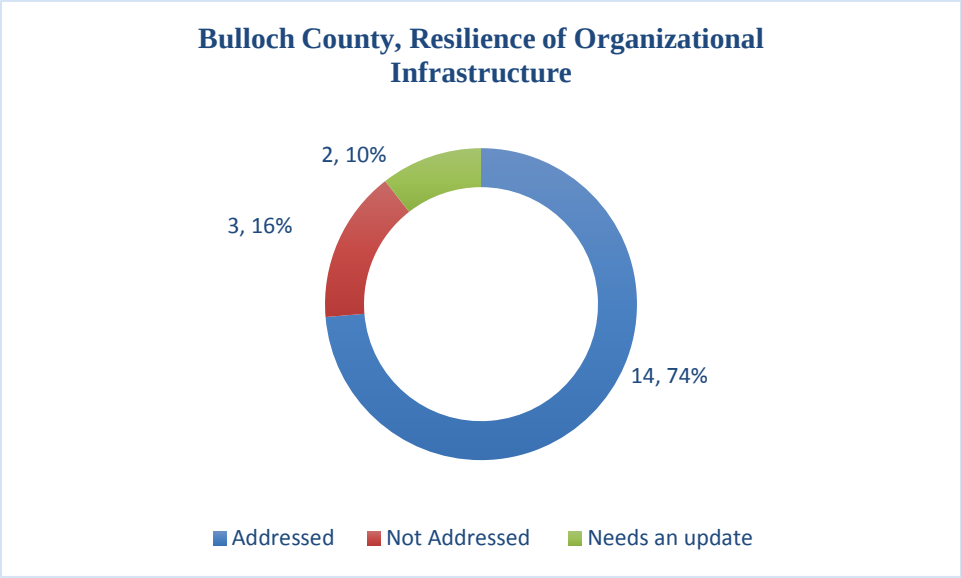
Note: The total number of issues identifies for resiliency of physical infrastructure are 17

- **Missing sections of planning documents:**

a) Evaluate the physical condition of critical infrastructure

b) Special health care facility for the population group associated with the critical infrastructure

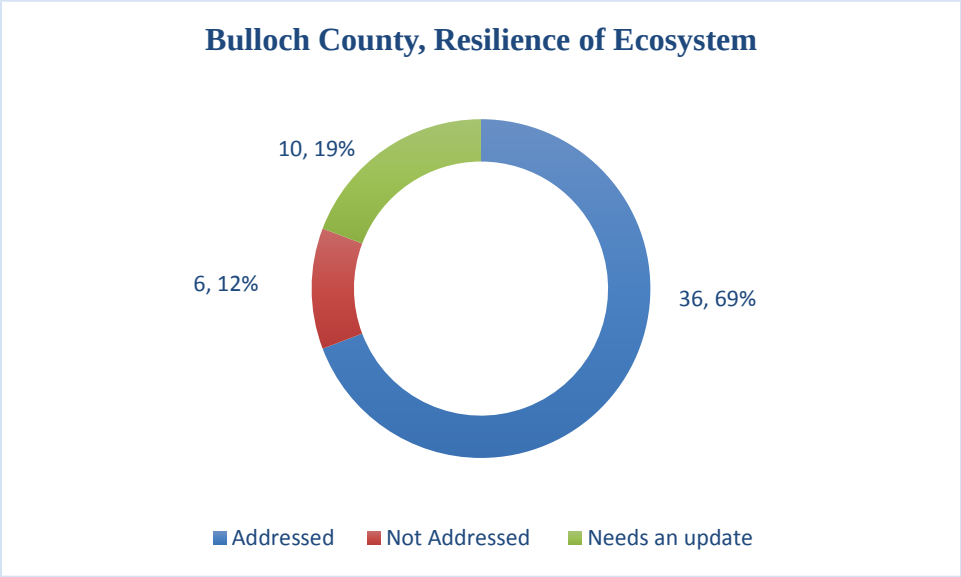
3) Resilience of organizational infrastructure:



Note: The total number of issues identifies for resiliency of organizational infrastructure is 19

- **Sections of planning document that needs an update are:**
  a) Disaster warning system
  b) Partnership with the response team to assist during the disaster
- **Missing sections of planning documents:**
  a) Awareness, supply management, and public outreach programs
  b) Post disaster, child care facility
  c) Post-disaster cleanup program

4) Resiliency of ecosystem:



Note: The total number of issues identifies for resiliency of ecosystem is 52.

- **Sections of planning document that needs an update are:**
  a) Air quality index for the counties
  b) Data on energy, and oil consumption
  c) Ecosystem management program
  d) Consideration for green power/ clean power production, and usage

- **Missing sections of planning documents:**
  a) Measuring the change in natural buffer
  b) Shore line protection policies (if valid)
  c) Measuring the increase in heat island effect in the area

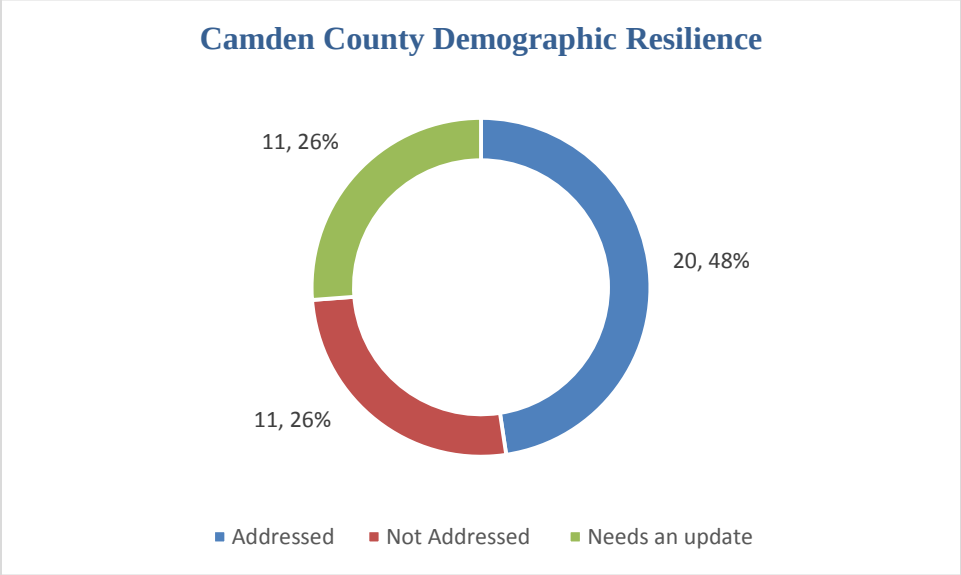
The final resilience score of the Bulloch County (based on the available documents for review) i:

- Total no of issues: 130
- Addressed: 92 (1 point each) = 92 points
- Needs and update: 15 (0.5 points each) = 7.5 points

Resilience score of Bulloch County, GA = 99.5 points

Camden County Summary Report

1) Demographic Resilience



Note: The total number of issues identifies for demographic resilience are 42

- **Sections of planning document that needs an update are:**
  a) Addressing different population types in the hazard management plan
  b) Emergency medical center's locations for both general public, and critical population
  c) Back-up plans for the emergency supply in the medical centers
  d) Temporary shelter, and health care facility for the local population during the disaster
  e) Calculating the estimate loss by natural event by calculating the property value in the hazard zone
  f) Considering special needs, and evacuation plans required for the critical population group, and the vulnerable population like, population under poverty line
- **Missing sections of planning documents:**
  a) Percentage of critical group pf population (population above age group of 65 years, or below 5 years of age group, along with the people suffering from chronic disease) under natural hazard zone
  b) Animal rescue centers

c) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)

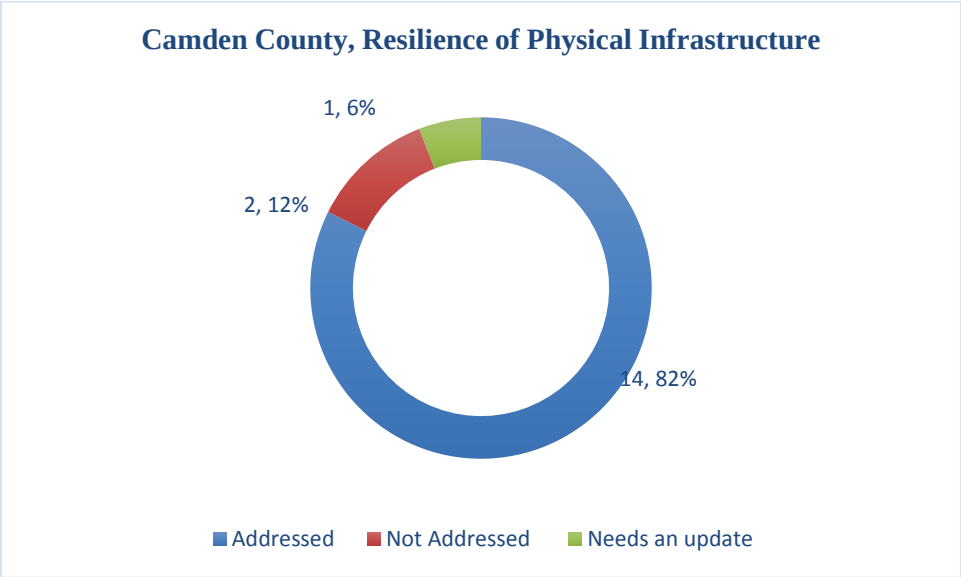
d) Mapping the major concentration (hot-spot) of economic center

e) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)

f) Special insurance program for the critical section of population during the recovery process

g) Special education and outreach program for the critical section of population

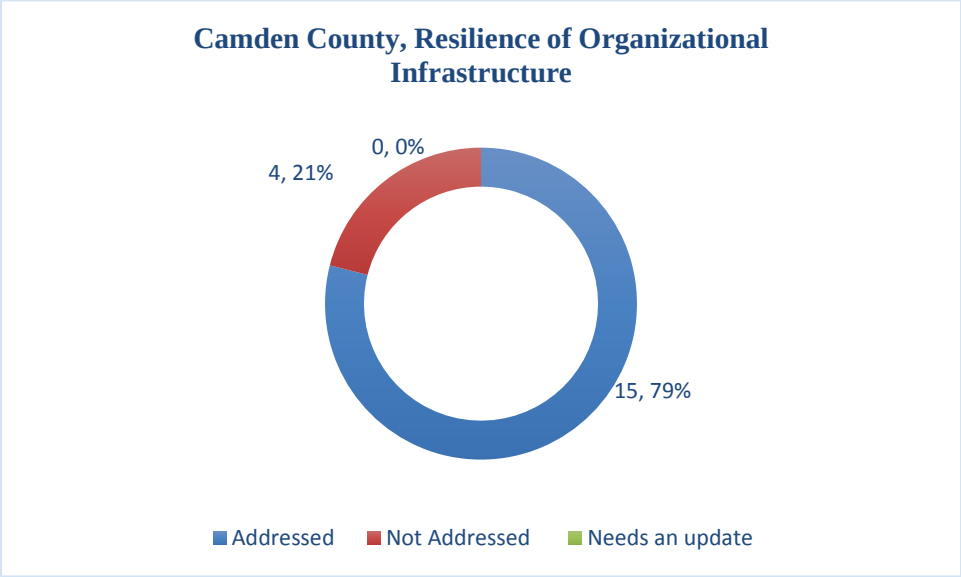
2) Resilience of Physical infrastructure:



Note: The total number of issues identifies for resiliency of physical infrastructure are 17

- **Sections of planning document that needs an update are:**
  a) Relocation policy for critical infrastructures
- **Missing sections of planning documents:**
  a) Map the identified critical infrastructure in hazard zone, to understand the potential damage.
  b) Calculating social, and economical impact of disturbance in the identified critical infrastructure

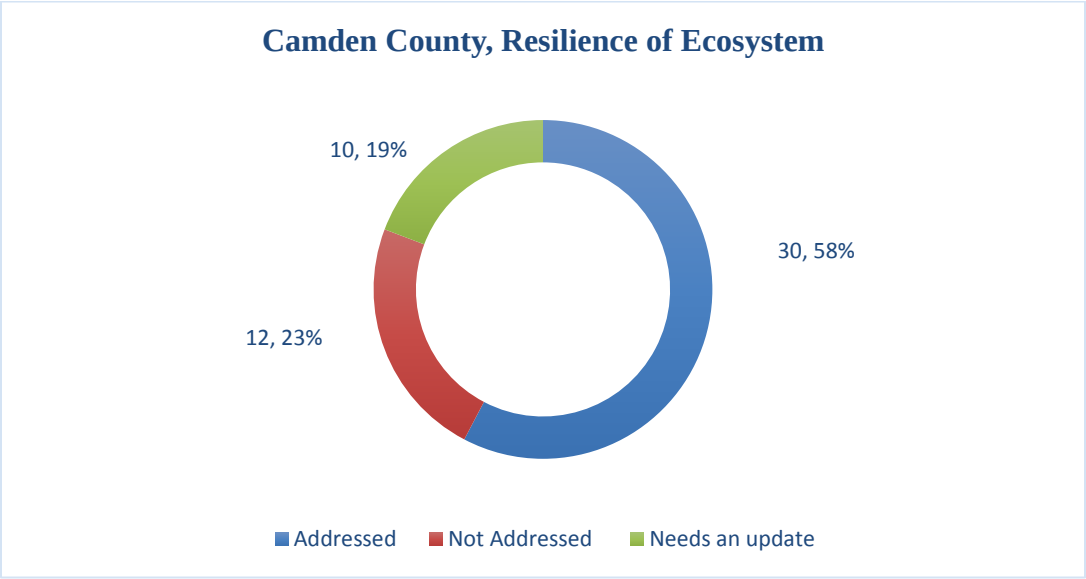
3) Resilience of Organizational Infrastructure:



Note: The total number of issues identifies for resiliency of organizational infrastructure is 19

- **Missing sections of planning documents:**
  a) Disaster warning system
  b) Post disaster, child care facility
  c) Post-disaster cleanup program

4) Resiliency of ecosystem:



Note: The total number of issues identifies for resiliency of ecosystem is 52.

- **Sections of planning document that needs an update are:**
  a) Air quality index for the counties

b) Data on energy, and oil consumption
c) Percentage of urban and rural development

- **Missing sections of planning documents:**
  a) Effects of change in landscape pattern on Agriculture production (if valid)
  b) Change in precipitation level
  c) Measuring the change in natural buffer
  d) Clean air and water act
  e) Shore line protection policies (if valid)
  f) Measuring the increase in heat island effect in the area

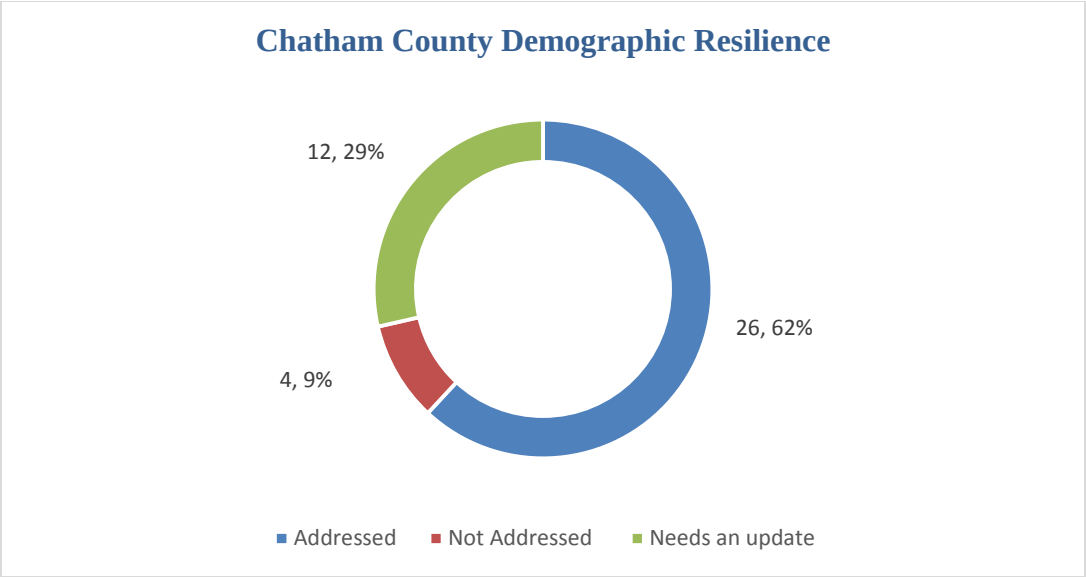
The final resilience score of Camden County (based on the available documents for review) is:

- Total number of issues: 130
- Addressed: 79 (1 point each) = 79 points
- Needs and update: 22 (0.5 points each) = 11 points

Resilience score of Camden County, GA = 90 points

Chatham County Summary Report

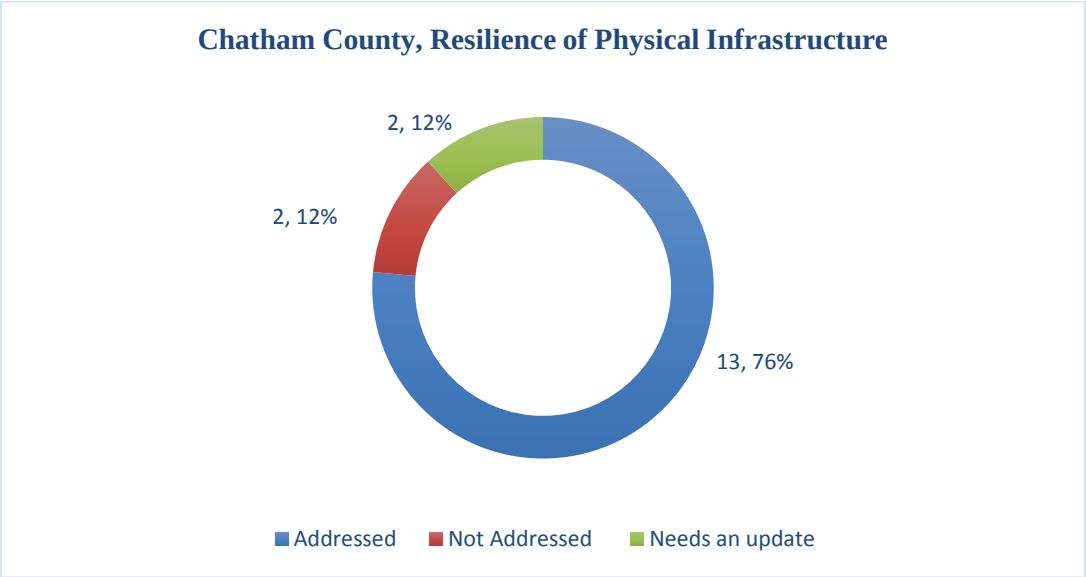
1) Demographic Resilience



Note: The total number of issues identifies for demographic resilience are 42

- **Sections of planning document that needs an update are:**
  a) Critical facilities provided in hospitals for the case of emergency
  b) Back-up plans for the emergency supply in the medical centers
  c) Temporary shelter, and health care facility for the local population during the disaster
  d) Calculating the estimate loss by natural event by calculating the property value in the hazard zone
  e) Child care center
  f) Construction standards/ codes
  g) Insurance policies for buildings under hazard zone
  h) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)
- **Missing sections of planning documents:**
  a) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)
  b) Awareness and disaster relief programs
  c) Relocation plans for the critical infrastructure from the hazard zone

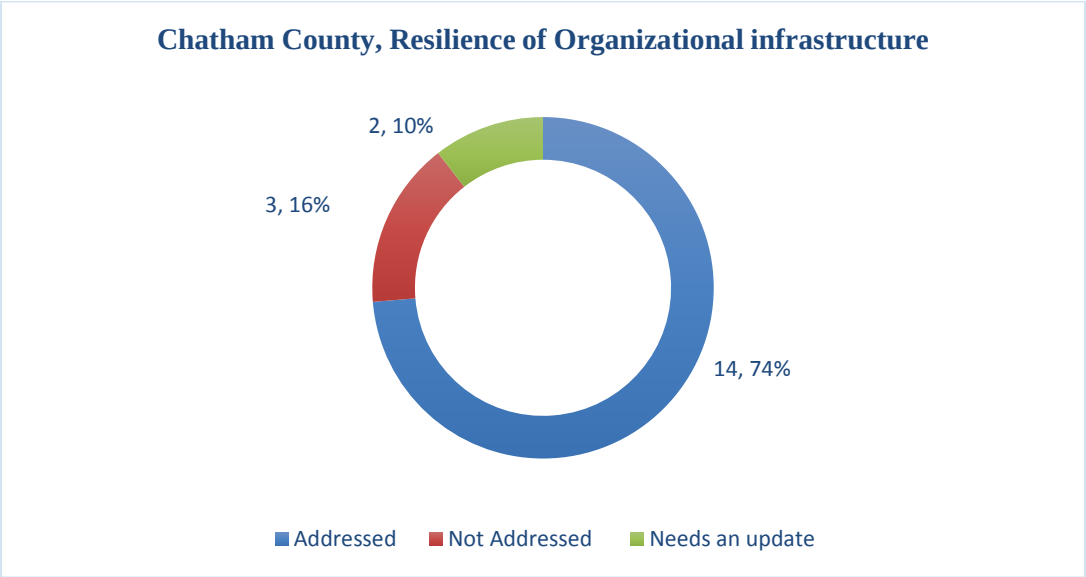
2) Resilience of Physical infrastructure:



Note: The total number of issues identifies for resiliency of physical infrastructure are 17

- **Sections of planning document that needs an update are:**
  a) Evaluate the physical condition of critical infrastructure
  b) Funding, and policies for improving the condition of critical infrastructures
- **Missing sections of planning documents:**
  a) Map the identified critical infrastructure in hazard zone, to understand the potential damage.
  b) Special health care facility for the population group associated with the critical infrastructure

3) Resilience of Organizational Infrastructure:

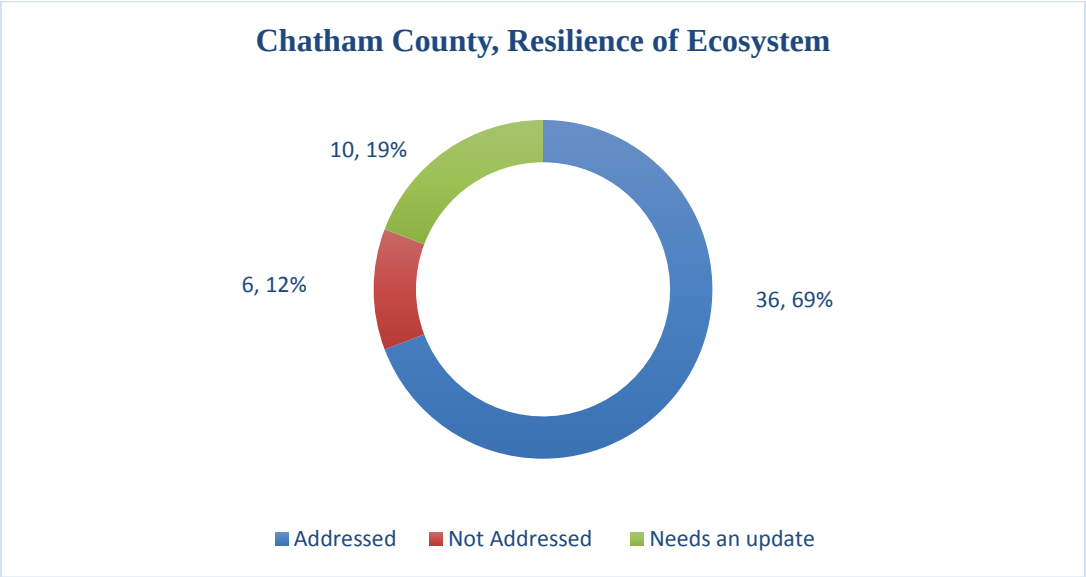


Note: The total number of issues identifies for resiliency of organizational infrastructure is 19

- **Sections of planning document that needs an update are:**
  a) Disaster warning system
  b) Partnership with the response team to assist during the disaster

- **Missing sections of planning documents:**
  c) Awareness program
  d) Post disaster, child care facility
  e) Post-disaster cleanup program

4) **Resiliency of Ecosystem:**



Note: The total number of issues identifies for resiliency of ecosystem is 52.

- **Sections of planning document that needs an update are:**
  a) Air quality index for the counties
  b) Data on energy, and oil consumption

- **Missing sections of planning documents:**
  a) Measuring the change in natural buffer
  b) Shore line protection policies (if valid)
  c) Measuring the increase in heat island effect in the area

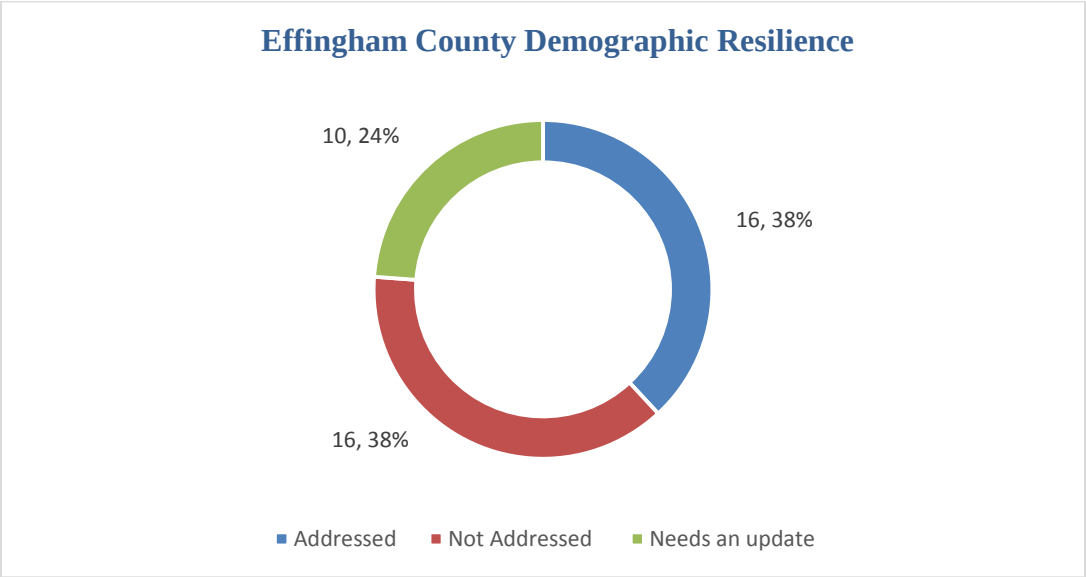
Thus the final resilience score of Chatham County (based on the available documents for review) is:

- Total no of issues: 130
- Addressed: 89 (1 point each) = 89 points
- Needs and update: 28 (0.5 points each) = 14 points

Resilience score of Chatham County, GA = 103 points

Effingham County Summary Report

1) Demographic Resilience

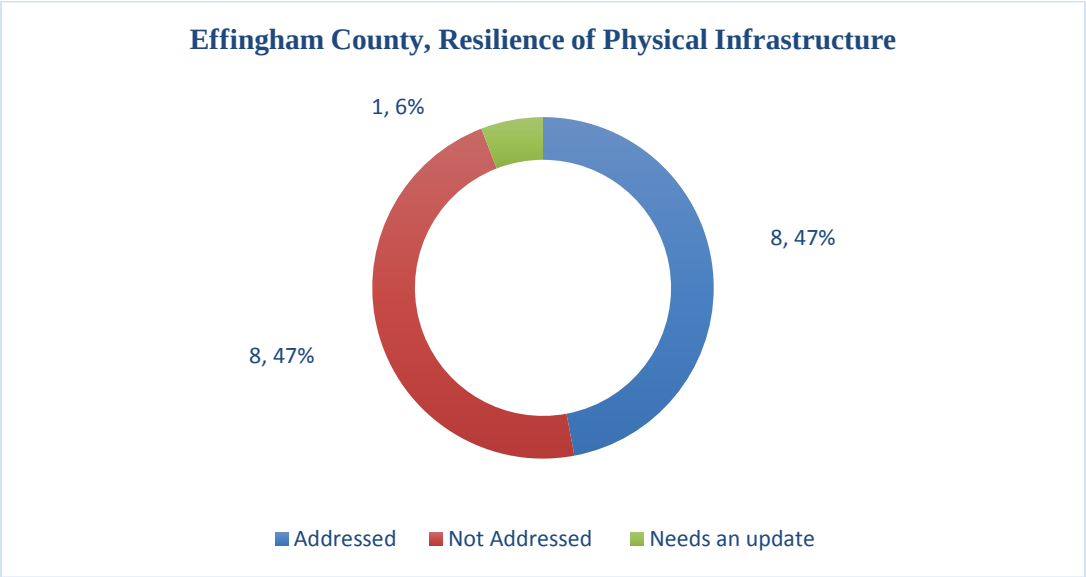


Note: The total number of issues identifies for demographic resilience are 42

- **Sections of planning document that needs an update are:**
  a) Zone of impact of natural event
  b) Addressing different population types in the hazard management plan
  c) Critical facilities provided in hospitals for the case of emergency
  d) Considering critical populations (population above the age group of 65 years, and below 5 years of age), and population with chronic diseases.
  e) Understanding the census data of the city/ County
  f) Construction standards/ codes
  g) Relocation plans for the critical infrastructure from the hazard zone
  h) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)
- **Missing sections of planning documents:**
  a) Emergency medical center's locations for both general public, and critical population
  b) Critical facilities provided in the medical center for emergency situations
  c) Back-up plans for the emergency supply in the medical centers

d) Child care center
e) Animal rescue center
f) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)
g) Mapping the major concentration (hot-spot) of economic center
h) Special arrangements like, early evacuation facility, food supply, medical care, etc. for critical section of population.
i) Special insurance program for the critical section of population during the recovery process
j) Special education and outreach program for the critical section of population.

2) Resilience of Physical infrastructure:



Note: The total number of issues identifies for resiliency of physical infrastructure are 17

- **Sections of planning document that needs an update are:**
  a) Calculating social, and economical impact of disturbance in functioning of few major infrastructure like, electricity, water, food supply, and road conditions.
- **Missing sections of planning documents:**
  a) Validating the identified critical infrastructure identified for the city with the standard list of documents provided by Federal or national agencies

b) Map the identified critical infrastructure in hazard zone, to understand the potential damage.

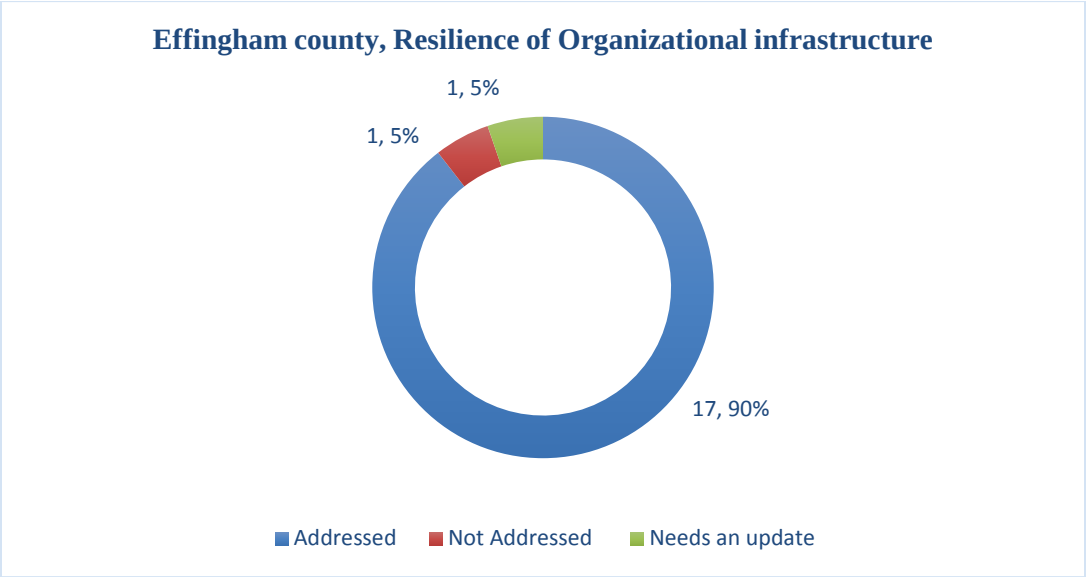
c) Evaluate the physical condition of critical infrastructure

d) Special insurance policies for the critical infrastructure under the Hazard zone

e) Relocation policy for critical infrastructures

f) Special health care facility for the population group associated with the critical infrastructure

3) Resilience of organizational infrastructure:



Note: The total number of issues identifies for resiliency of organizational infrastructure is 19

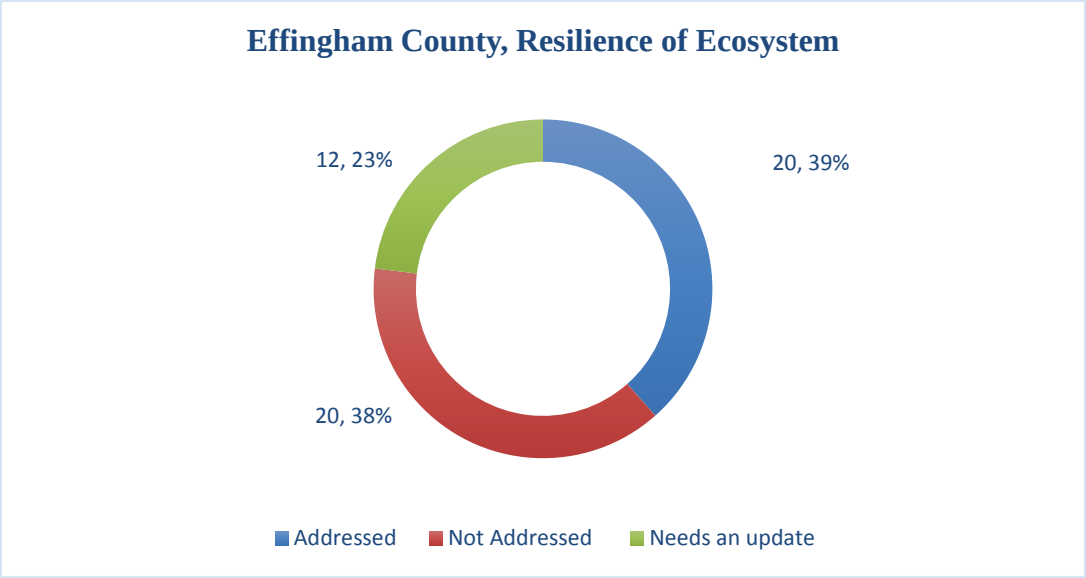
- **Sections of planning document that needs an update are:**

  a) Policies for defining critical infrastructure

- **Missing sections of planning documents:**

  a) Post disaster, child care facility

4) Resiliency of ecosystem:



Note: The total number of issues identifies for resiliency of ecosystem is 52.

- **Sections of planning document that needs an update are:**
  a) Air quality index for the counties
  b) Data on energy, and oil consumption
  c) Water quality
- **Missing sections of planning documents:**
  a) Existing land use pattern
  b) Change in land use pattern
  c) Urban and Rural areas
  d) Measuring the change in natural buffer
  e) Change in temperature and precipitation
  f) Change in ground water level and annual sea level rise
  g) Clean air act
  h) Shore line protection policies (if valid)
  i) Tools for producing green power for the city/county
  j) Measuring the increase in heat island effect in the area
  k) Coastal mapping

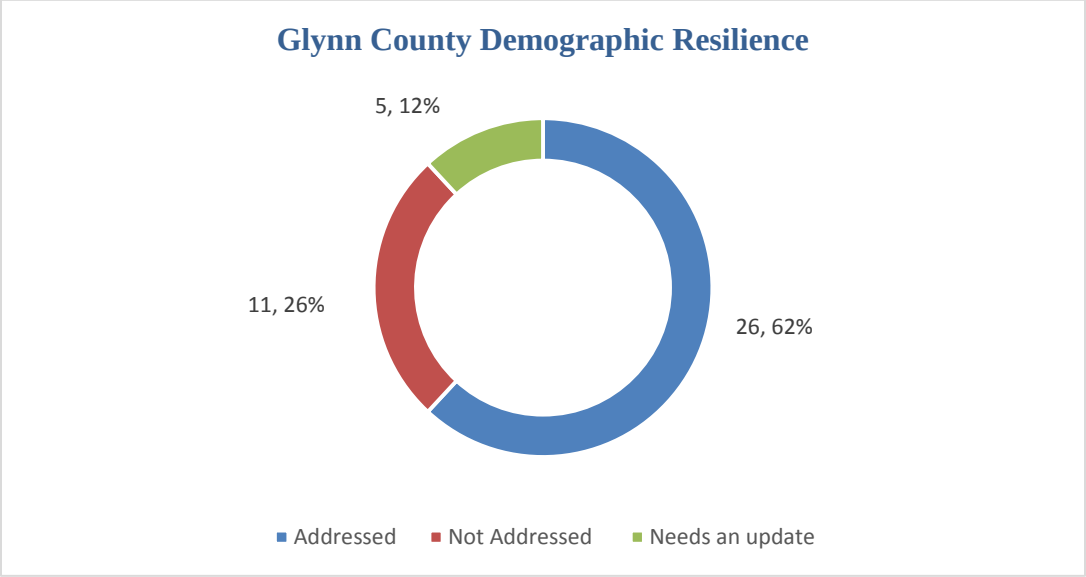
The final resilience score of Effingham County (based on the available documents for review) is:

- Total no of issues: 130
- Addressed: 61 (1 point each) = 61 points
- Needs and update: 24 (0.5 points each) = 12 points

Resilience score of Effingham county, GA = 73 points

Glynn County Summary Report

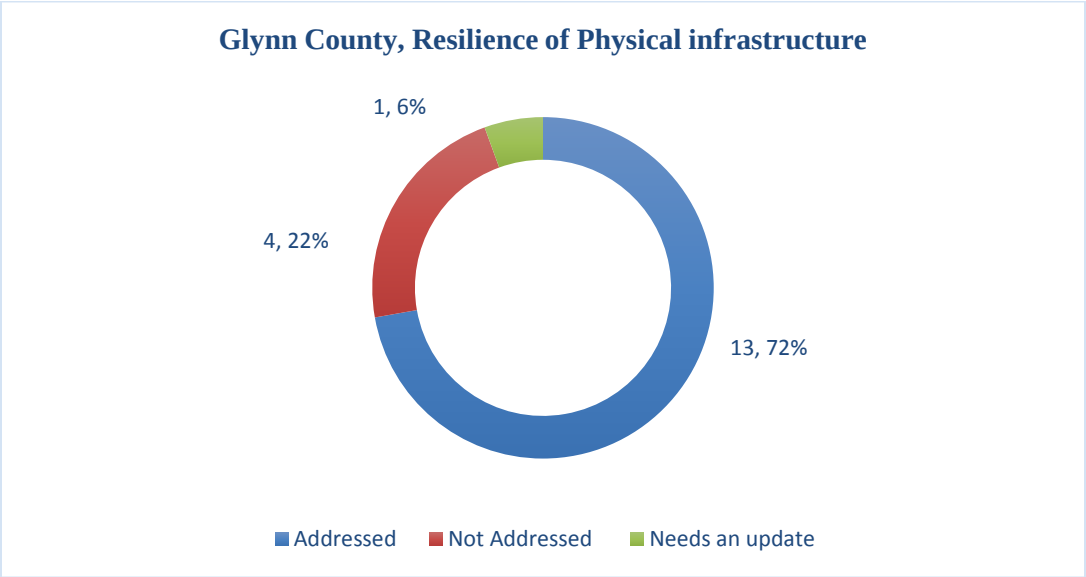
1) **Demographic Resilience**



Note: The total number of issues identifies for demographic resilience are 42

- **Sections of planning document that needs an update are:**
  a) Relocation plans for the critical infrastructure from the hazard zone
  b) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)
- **Missing sections of planning documents:**
  a) Mapping the major concentration (hot-spot) of economic center
  b) Emergency medical center's locations for both general public, and critical population
  c) Critical facilities provided in the medical center for emergency situations
  d) Back-up plans for the emergency supply in the medical centers
  e) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)
  f) Special arrangements like, early evacuation facility, food supply, medical care, etc. for critical section of population.
  g) Special insurance program for the critical section of population during the recovery process

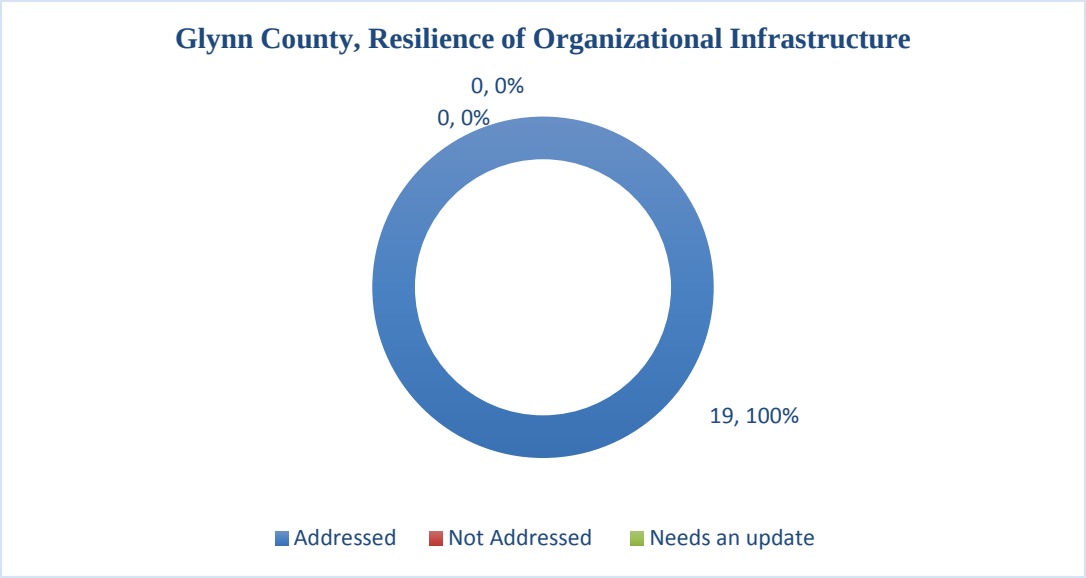
2) Resilience of Physical infrastructure:



Note: The total number of issues identifies for resiliency of physical infrastructure are 17

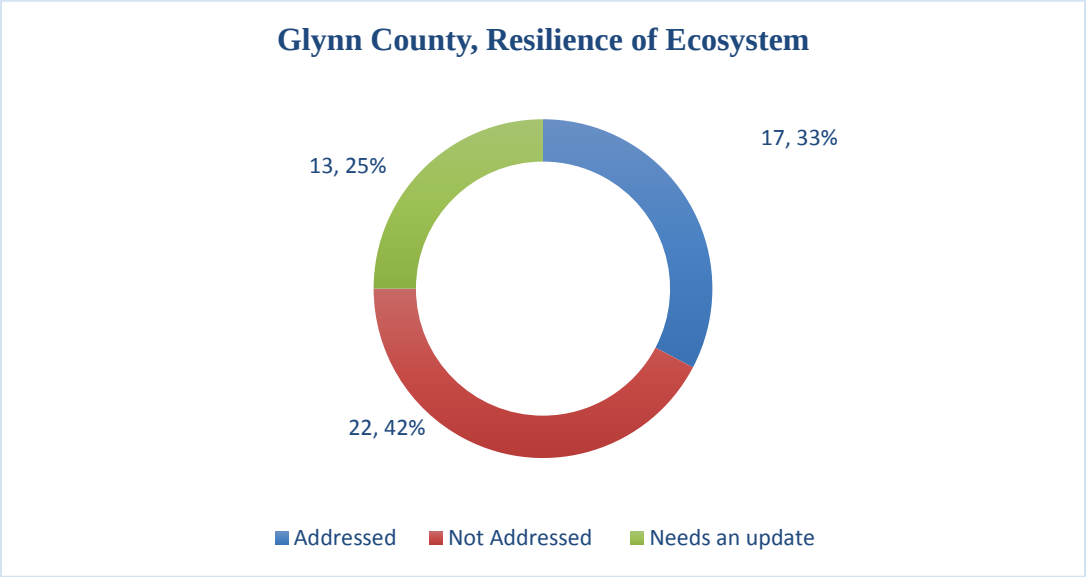
- **Missing sections of planning documents:**
  a) Evaluate the physical condition of critical infrastructure
  b) Special insurance policies for the critical infrastructure under the Hazard zone
  c) Special health care facility for the population group associated with the critical infrastructure

3) Resilience of organizational infrastructure:



Note: The total number of issues identifies for resiliency of organizational infrastructure is 19

4) Resiliency of Ecosystem:



Note: The total number of issues identifies for resiliency of ecosystem is 52.

- **Sections of planning document that needs an update are:**

  a) Air quality index for the counties

  b) Data on energy, and oil consumption

  c) Water quality

  d) Ecosystem management program

- **Missing sections of planning documents:**

  a) Existing land use pattern

  b) Change in land use pattern

  c) Urban and Rural areas

  d) Measuring the change in natural buffer

  e) Change in temperature and precipitation

  f) Clean air act

  g) Shore line protection policies (if valid)

  h) Tools for producing green power for the city/county

  i) Measuring the increase in heat island effect in the area

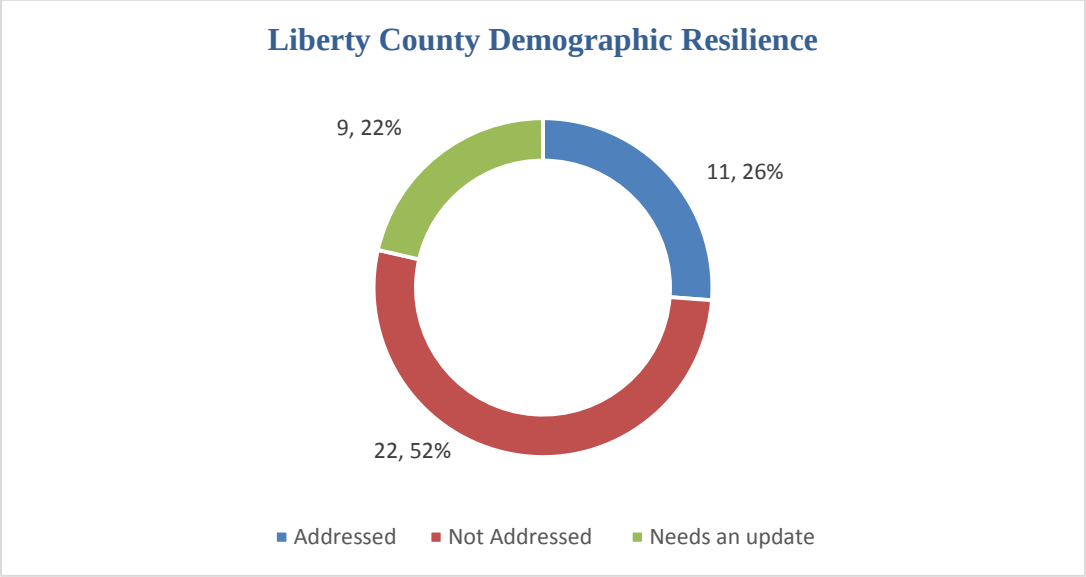
The final resilience score of the Glynn County (based on the available documents for review) is:

- Total no of issues: 130
- Addressed: 75 (1 point each) = 75 points
- Needs and update: 19 (0.5 points each) = 9.5 points

Resilience score of Glynn County, GA = 84.5 points

Liberty County Summary Report

1) **Demographic Resilience**



Note: The total no of issues identifies for demographic resilience are 42

- **Sections of planning document that needs an update are:**
  a) Understanding the population type
  b) Emergency medical center's locations for both general public, and critical population
  c) Construction codes
  d) Special insurance policy for the buildings in the estimated zone of natural event
  e) Calculating the estimate loss by natural event by calculating the property value in the hazard zone
  f) Special arrangements like, early evacuation facility, food supply, medical care, etc. for critical section of population

- **Missing sections of planning documents:**
  a) Evaluation of percentage of critical population within the hazard zone
  b) Mapping the major concentration (hot-spot) of economic center
  c) Emergency medical center's locations for both general public, and critical population
  d) Back-up plans for the emergency supply in the medical centers
  e) Education and outreach program for both general public and critical population

f) Location of evacuation shelters for the local population

g) Child care facility

h) Animal rescue center

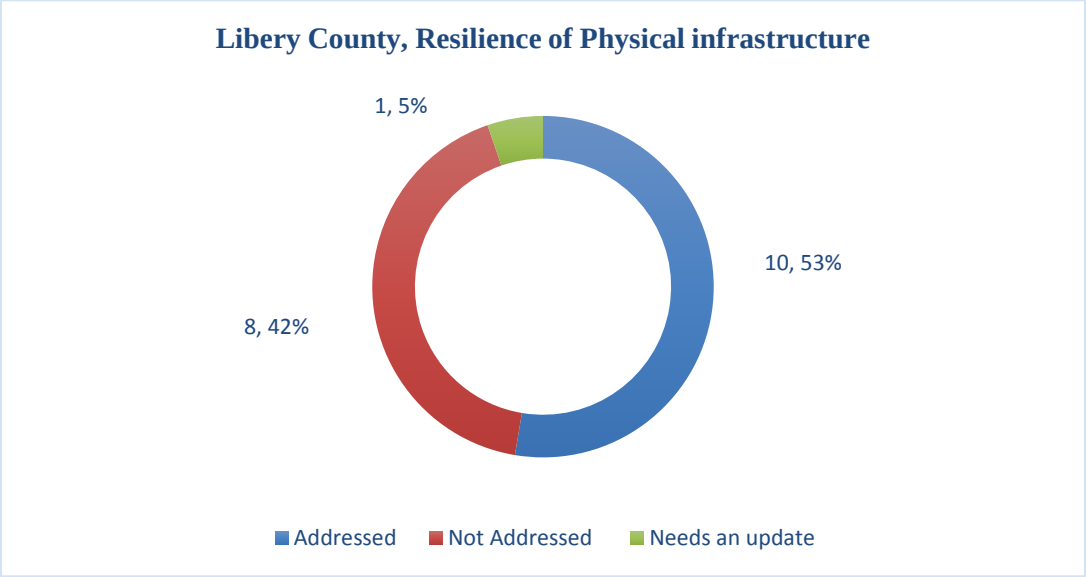
i) Special evacuation plan for tourist (if that is one of the major economic source for the cities, and county)

j) Relocation plan for critical infrastructures

k) Special arrangements like, early evacuation facility, food supply, medical care, etc. for critical section of population.

l) Special insurance program for the critical section of population during the recovery process

2) Resilience of Physical infrastructure:



Note: The total number of issues identifies for resiliency of physical infrastructure are 17

- **Sections of planning document that needs an update are:**
  a) Understanding the zone of impact of natural disaster

- **Missing sections of planning documents:**
  a) Identification of frequently used infrastructure
  b) Validating the identified critical infrastructure identified for the city with the standard list of documents provided by Federal or national agencies
  c) Mapping the identified critical infrastructure in the hazard impact zone

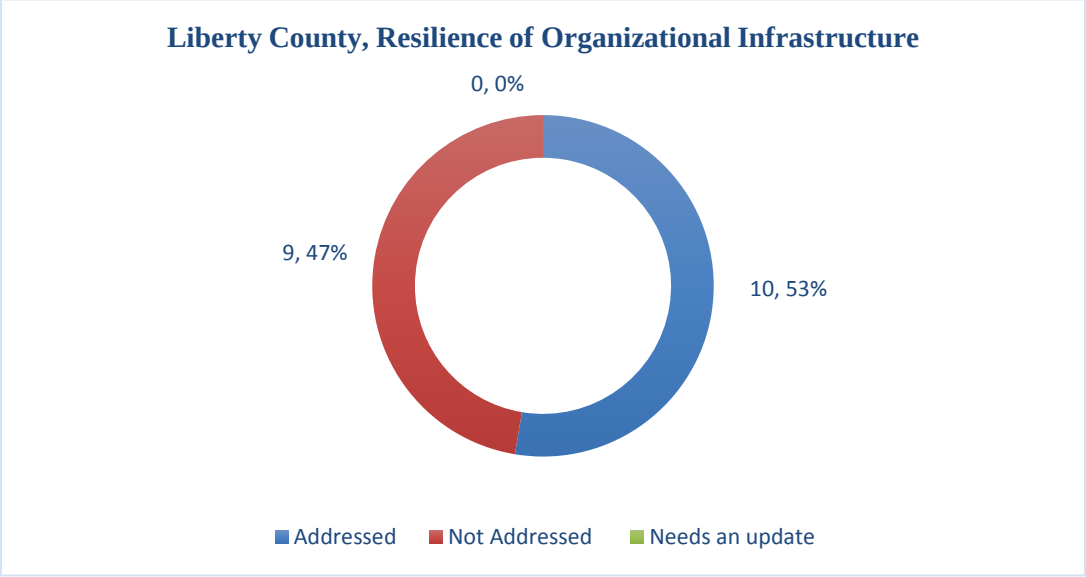
d) Evaluate the physical condition of critical infrastructure

e) Special insurance policies for the critical infrastructure under the Hazard zone

f) Identification of group of people associated with the critical infrastructure

g) Special health care facility for the population group associated with the critical infrastructure

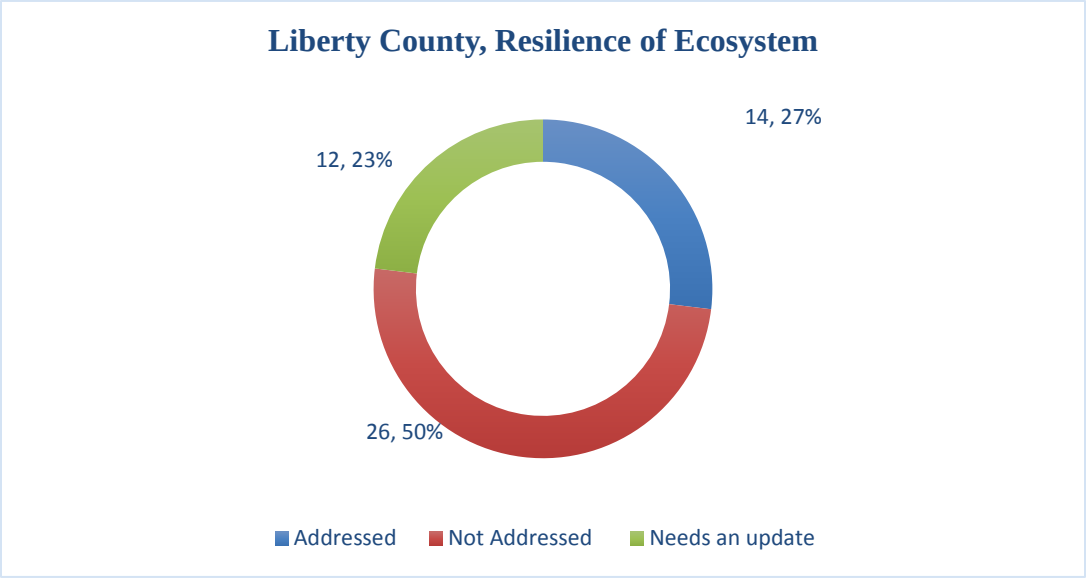
3) Resilience of organizational infrastructure:



Note: The total number of issues identifies for resiliency of organizational infrastructure is 19

- **Missing sections of planning documents:**
  a) Social impact of the disaster event
  b) Identification of critical infrastructure
  c) Awareness, supply management, and public outreach programs
  d) Partnership with the response team to assist during the disaster
  e) Temporary shelter, and health care facility for the local population during the disaster
  f) Child care facility
  g) Post-disaster cleanup program
  h) Post-disaster recovery program

4) Resiliency of ecosystem:



Note: The total number of issues identifies for resiliency of ecosystem is 52.

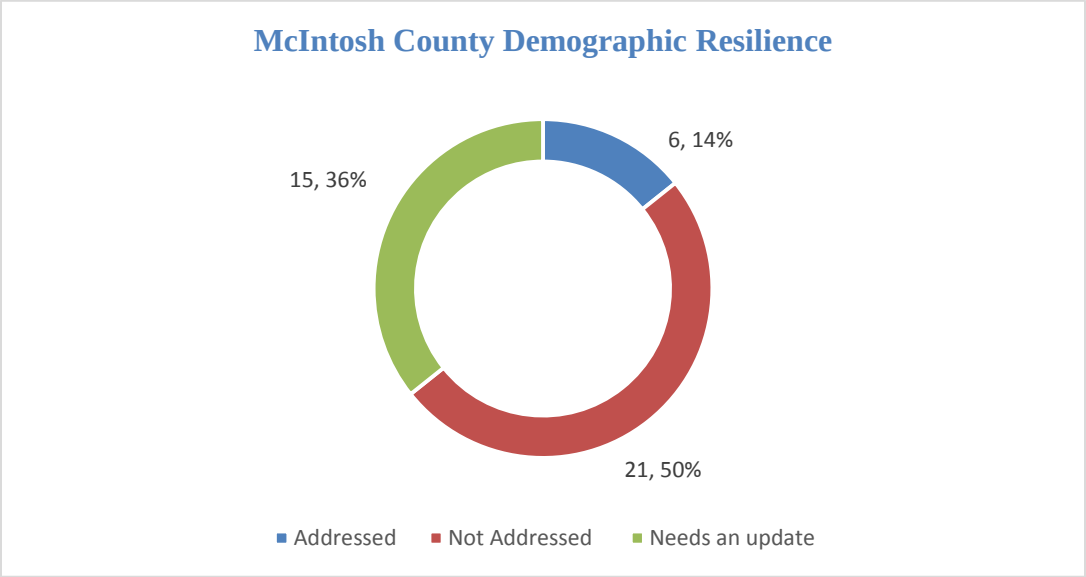
Thus the final resilience score of the Liberty County (based on the available documents for review) is:

- Total no of issues: 130
- Addressed: 45 (1 point each) = 45 points
- Needs and update: 22 (0.5 points each) = 11 points

Resilience score of Liberty County, GA = 56 points

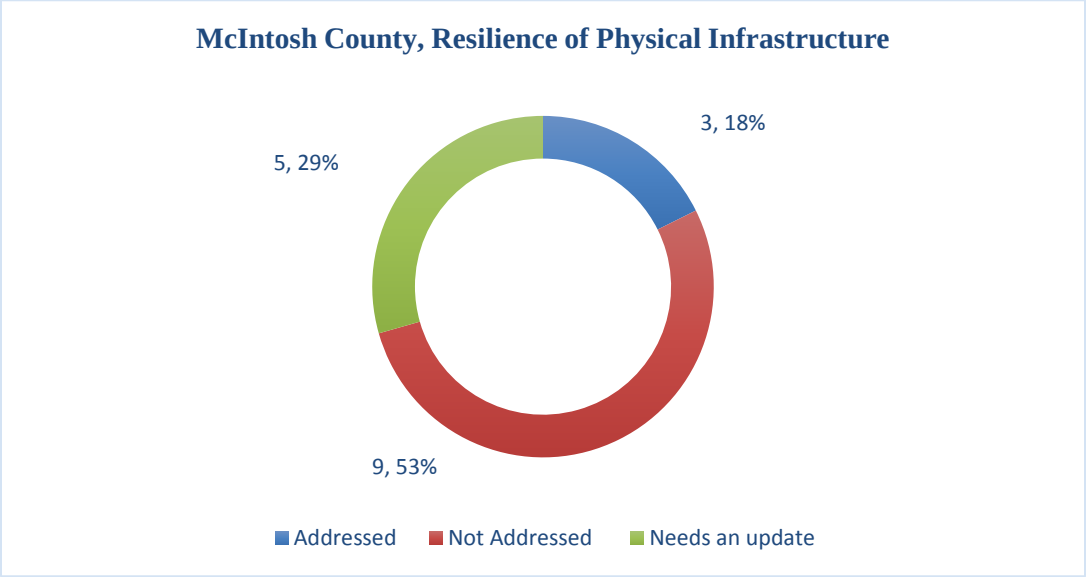
McIntosh County Summary Report

1) Demographic Resilience



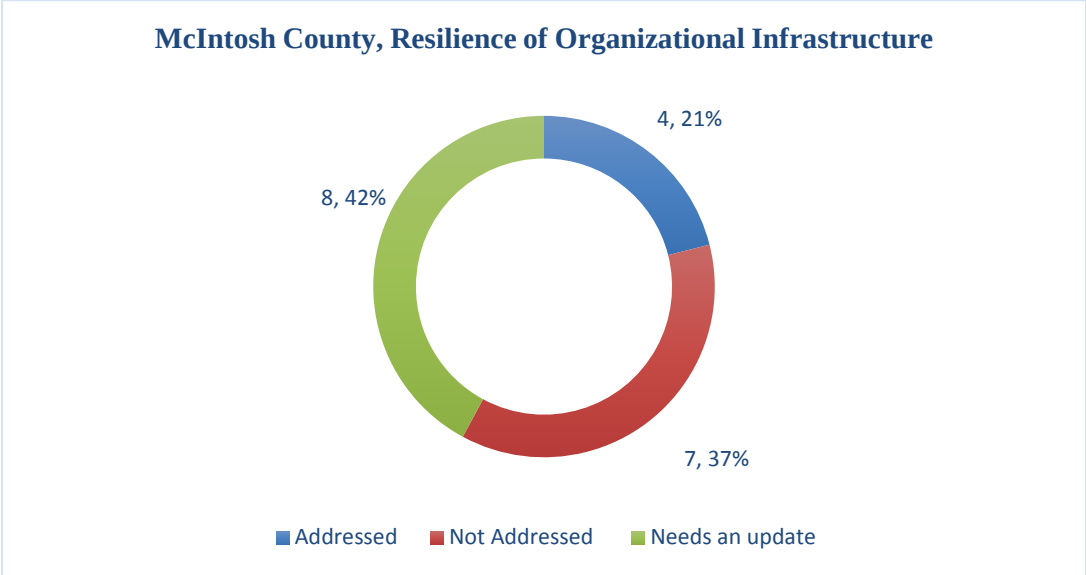
Note: The total number of issues identifies for demographic resilience are 42

2) Resilience of Physical infrastructure:



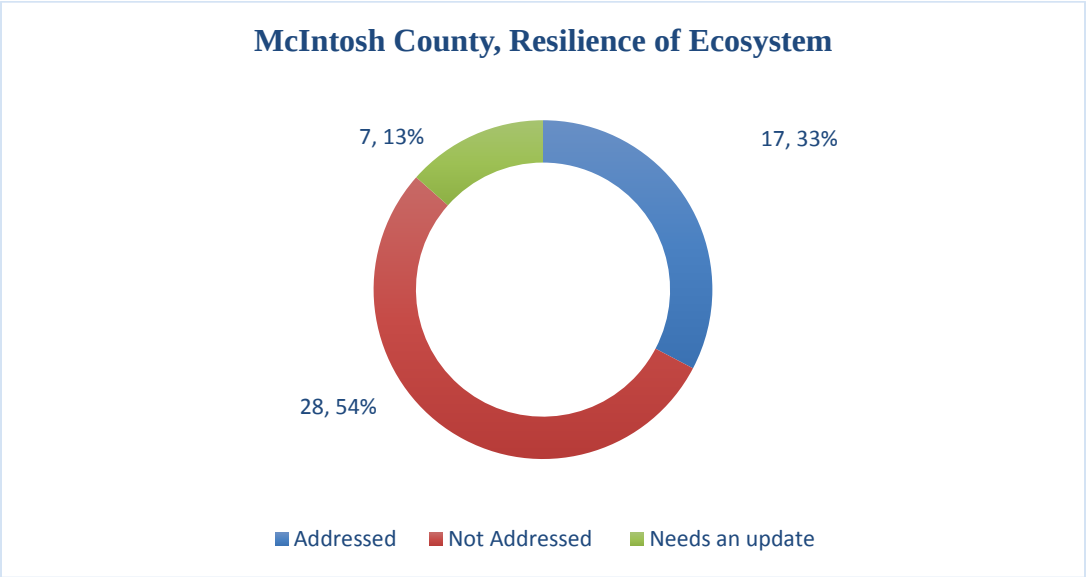
Note: The total number of issues identifies for resiliency of physical infrastructure are 17

3) **Resilience of organizational infrastructure:**



Note: The total number of issues identifies for resiliency of organizational infrastructure is 19

4) **Resiliency of Ecosystem:**



Note: The total number of issues identifies for resiliency of ecosystem is 52.

The final resilience score of the McIntosh County (based on the available documents for review) is: Total no of issues: 130

- Addressed: 30 (1 point each) = 45 points
- Needs and update: 35 (0.5 points each) = 17.5 points

Resilience score of McIntosh county, GA = 61.5 points

Conclusion

Next Step Regional Agenda

The CRC is armed with the data, maps, and checklists that evaluate the performance of planning documents specifically for managing the conditions generated by the impact of a natural event. The identified missing portions of documents and the ***Resiliency Matrix Tool*** are a straightforward framework for evaluating the performance of planning documents. Although the State of Georgia has a statewide hazard mitigation element it is not adopted by cites in their comprehensive plan. The matrix can both be easily used for evaluation of planning documents and be updated depending upon the type of natural event. Additionally, the Assessment and matrix can be used in conjunction with the Georgia Department of Community Affairs (DCA**)** **2014 Best Practice Guidebook**: ***Community Disaster Resilience***. This guidebook was created to assist Georgia counties and cities with preparedness for natural hazards and disaster resiliency. DCA studied 20 Georgia counties that were impacted by flooding, severe storms and tornadoes in 2008, and the report describes recommended strategies for coordinating land use planning with hazard mitigation planning. According to DCA, these best practices can be incorporated into planning activities and include specific actions to implement plans and policies.

GA DCA and the CRC Council recognize the benefits and opportunities of integrating hazard mitigation into planning through updates of comprehensive plans, as it promotes consistency between plans; increases the visibility of mitigation goals, objectives and policies; properly guides future development and land use; and, improves coordination between planners and emergency managers.

One of the CRC Planning & Government Services Department aim is to continue to provide access to GIS data and spatial tools to each jurisdiction. This vision puts the data and tools in the hands of economic developers, planners, elected officials, emergency management to better facilitate access in real time. Providing tools and access to GIS data and spatial tools helps stakeholders make better informed decisions. The following categories can be included as part of the resilient community's discussion:

Re-Entry Analysis

- Decision Making
- Communication Process
- Storm Damage Impact Analysis
- Roadway Network

Business Mitigation & Recovery Analysis

- Impact Assessment
- Mitigation Assessment
- Economic Impact Study
- Recovery Analysis
- Redevelopment Planning

Community Storm Impact Analysis

- Coastal Erosion Mapping
- Inland Flood Analysis
- Critical Facility and Utility

Recovery Analysis

- Debris Management Planning
- Public Health
- Temporary Housing

Communication Assessment

- Public Information Process Analysis
- Interoperability Communications Planning Analysis

Technology Analysis

- GIS Applications
- Enhanced Decision Tool Updates

Disaster Mitigation Analysis

- Building Code Impact Analysis
- Zoning Analysis
- Community Rating System Analysis
- HAZUS Implementation
- Public Education and Outreach

The CRC's Regional Assessment is an evidence-based and peer reviewed planning process with clear methodology from a vigorous science basis. The University of Georgia College of Environment + Design presented initial findings at the American Planning Association (APA) GA Chapter State Conference on Jekyll Island. The CRC Regional Assessment, the Resiliency Matrix Tool, DCA's Best Practices, FEMA's Comprehensive Hurricane Emergency Management Strategies, and access to data and GIS applications, together can assist groups, stakeholders, policy makers, state and federal agencies in crafting appropriate guiding principles, effective work programs and operative performance standards in the Regional Plan Update to reduce risk to citizens, account for the long-term health of the ecosystems and ensure the continued delivery of services.

2014

College of Environment and Design

HAZARD AND RESILIENCE PLAN FOR THE COAST OF GEORGIA

Draft Report – February 2014

Prepared for the Coastal Regional Commission of Georgia

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Introduction

This project intends to support the planning efforts of the Coastal Regional Commission of Georgia (CRC) by providing research, technical analysis, and by identifying strategies which the CRC can employ to integrate Hazard Mitigation into the Regional Plan and ultimately into local planning.

This is an ongoing project, with the first phase executed in fall 2013 during a Regional Environmental Planning Studio class led by Professor Rosanna Rivero with participation of 13 graduate students at the Master of Environmental Planning and Design (MEPD) program, College of Environment and Design, University of Georgia.

The general objective of this project is to incorporate ideas of resilience into the existing Regional Plan of Georgia, adopted by the CRC council in June 2010, and amended in January 2012. The Regional Plan is a document representing shared agreements for clear, specific, and achievable strategies among primary stakeholders (local governments), governmental agencies and citizens as they help shape coastal Georgia's future.

The CRC 2014-2019 Work Program identifies amending the Regional Plan to include Resilient Communities as a topic of importance with the aim of integrating hazard mitigation planning into the regional plan. With this purpose in mind, the UGA team followed the FEMA's guidelines, as part of the agreement with the CRC: 4- Review of Community Capabilities, 5- Conduct a Risk Assessment, and 6- Develop a Mitigation Strategy, with the corresponding worksheets provided in the FEMA Manual. However, during the course of the semester, and following the Studio's general objectives and approach, these tasks were adjusted to fit the CRC regional plan structure for their Implementation Program (vision, guidelines principles, and performance standards) for each of their 6 "Topics of Importance". A 7th topic, Resilient Communities, will be incorporated into this list. These topics are: Infrastructure, Intrinsic Resources, Regional Growth Management, Economic Development, Preservation of Agricultural Land, Communities of Lifetime, and Resilient Communities.

Methods

Our project was divided into 2 general phases: the first phase was intended to provide an assessment of current conditions, by using existing data and information for each county, reviewing existing literature, conducting an assessment of comprehensive plans, ordinances, emergency management plans, and other reports, as provided by the CRC. Some of the tasks defined in the FEMA guidelines (risk assessment, with a description of hazards), description of community "assets", analysis of risk or impacts of the hazards to those assets, and summary of results and overall vulnerability for each community, are part of the first phase. We also used some of the elements of the Safe Growth Audit to conduct our assessment.

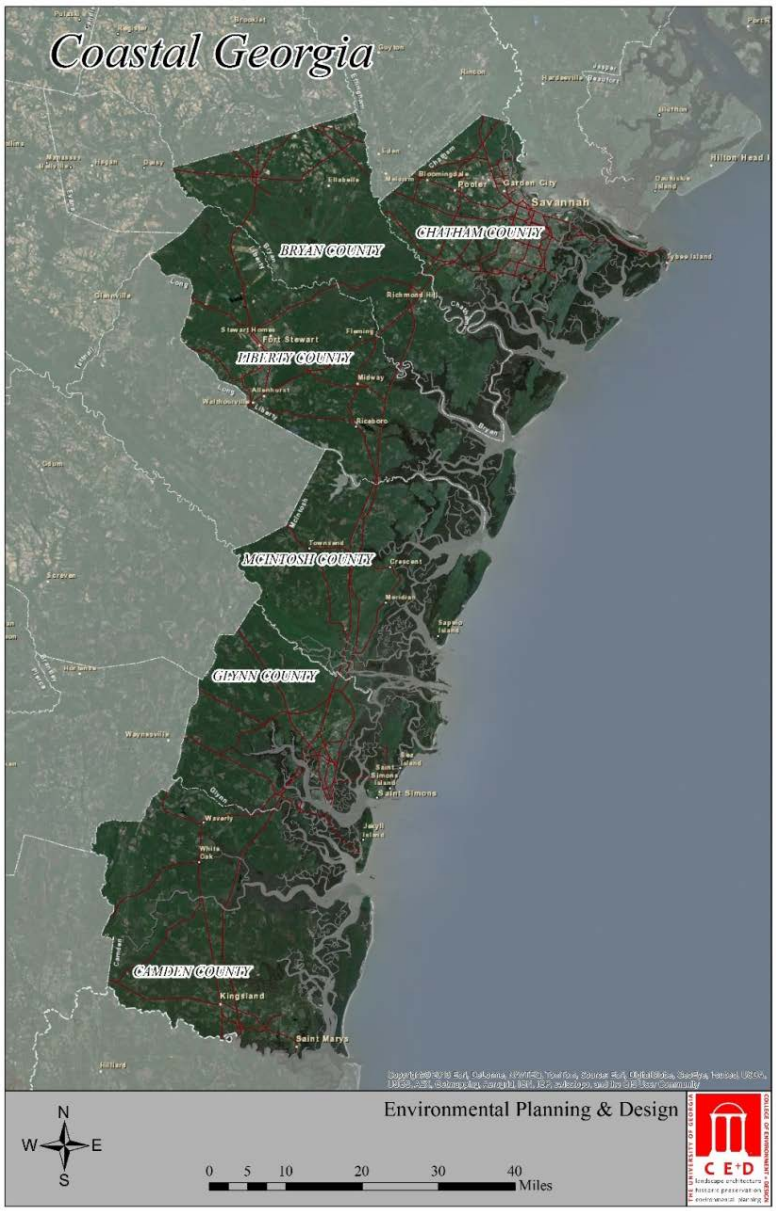
Results are summarized by an index of risk, vulnerability, and resilience, which varies with each theme or topic (e.g. built environment, infrastructure, and natural environment) that is based on a ranking system. This system addresses the level of risk and vulnerability by county or by hazard area, and provides a general assessment of how resilient a community is to any future hazards. In the second part of this first phase, a set of proposed recommendations and performance standards were created based upon the results found.

The second phase of this project includes the plan itself, following a combination of FEMA and CRC guidelines from their plans, including the vision, guiding principles, and performance measures (from CRC), integrated with a review of existing documents and assessment previously generated for the area, and other references. Preliminary results of this phase are presented in the study in the form of recommendations.

This document includes two sections: 1. Analysis of Existing Conditions (1.1 Natural Hazards, 1.2 Natural Environment, 1.3 Socio-Economic, 1.4 Infrastructure, and 1.5 Built Environment); 2.0 Proposal and Programs (2.1 Environmental Performance Standards, 2.2 Social and Economic Programs, 2.3 Comprehensive Plan and Community Agenda Proposals).

1. 0 Analysis of Existing Conditions

Before making recommendations that would affect how a region prepares for disaster, a thorough assessment of that region must be conducted. The six Georgia counties which are considered in this regional assessment are Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden, as shown in Map 1.0.1.



Map 1.0.1 Coastal Georgia Region with six counties (Chatam, Bryan, Liberty, McIntosh, Glynn, and Camden. Information provided by ESRI and GDOT.

1.1 Natural Hazard

Introduction

Coastal Georgia presents a socially diverse and ecologically important region within the Southeastern United States. Like many coastal regions sea level rise and hurricanes present a prevailing issue within this newly developing coast. Because of Georgia's low coastal elevation, it allows it to be extremely susceptible to the effects of sea level rise as predicted by NOAA and the Environmental Protection Agency. This low elevation can also cause detrimental flooding occurring due to storm surges from hurricanes. The coast has been fortunate in its avoidance of a major hurricane in over 100 years as reported by GEMA. But, luckiness does not mean impossibility. Planning for hurricanes and sea level rise is critical to the coasts ability to not only be resilient but also sustainable.

Methods

1) Collect data from NOAA, Georgia Clearinghouse, Dewberry, and GIS Gateway
2) Conduct a visual assessment of data and maps utilizing FEMA guidelines
3) Visual assessment of USGS Hazard Portal for sea level rise (lack of available data)
4) Collect data from other groups to assess where the most vulnerable areas along the coast are located

Assessment

The vulnerability assessment involves examining each county for their exposure to disasters utilizing the FEMA Local Mitigation Handbook guidelines outlined in Chapter 5. Listed below are diagrams of each county and their vulnerability as outlined by FEMA in Task 5, section 4: Conduct Risk Assessment, Summarize Vulnerability. The vulnerability ranking was given a color coded system, red being the most likely and most hazardous and blue being negligible with damage being unpredictable in severity. Each extent, location, and hazard probabilities utilized the description outlined in FEMA Task 5-3, Conduct Risk Assessment Analyze Risk. For the purposes of this assessment, sea level rise is assessed for a 6ft rise in 2100 as the extreme prediction by NOAA.

All of the charts show the risk assessment summary based on FEMA Worksheet 5.1 for each county and indicate that sea level rise, hurricanes, flooding, and storm surges are all prevailing issues within this region in all six counties. It exemplifies how a regional plan will not only be beneficial, but also necessary to the sustainability of the coast and the safety for the people who live there. Due to lightning and wildfires being random and unpredictable, special attention and focus needs to be put on good evacuation and regional plans that can serve multiple purposes.

Chatham County

Chatham County's main natural hazard threats are hurricanes, flooding, sea level rise, and storm surges. This county has a risk of severe flooding especially during times of hurricanes, storm surges, and sea level rise. All of these factors increase the likelihood of flooding in a county-wide extent. Extreme cold is unlikely in this area due to its location on the coast in the SE United States. In contrast, extreme heat is occasional due to the warm conditions along the coast as predicted by NOAA NOW data. Drought can be extreme on a county wide level and can become a likely occurrence based on low precipitation levels. A hurricane at any category can make landfall on the county, a category 5 being the most extreme but just as possible. Savannah was hit by a tropical storm that made landfall in the past 50 years. The storm surges caused by hurricanes can reach levels of 31 feet as predicted by NOAA. These storm surges can reach a county wide extent covering most of the county during a category 5 hurricane. Lightning for the purposes of this hazard document is considered negligible due to the unpredictability of lightning striking and whether or not a hazardous condition can occur. Lightning can cause wildfires which can occur in parts of the county but is also negligible due to unpredictability of extent and hazardous condition, wildfires burned 1,217.21 acres from 2004 through 2013 as reported by the Georgia Forestry Commission.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	Chatham	county wide, extensive	extreme	Likely	
Extreme Cold	Chatham	Savannah area-entire county, extensive	3*F, weak	unlikely	
Extreme Heat	Chatham	Savannah area-entire county, extensive	105*F, moderate	occasional	
Flood	Chatham	significant, covers a large portion of county	severe	highly likely	
Hurricane	Chatham	county wide, extensive	Category 5, extreme	occasional	
Lightning	Chatham	negligible	weak to moderate	occasional	
Sea Level Rise	Chatham	county wide, extensive	6 ft, extreme	highly likely	
Storm Surge	Chatham	county wide, extensive	Category 5/ 31 ft, extreme	highly likely	
Wildfire	Chatham	parts of county, negligible	1217.21 acres burned, moderate to severe	high in times of drought, likely	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.1. FEMA Hazard Summary Worksheet 5.1 for Chatham County. Extreme cold and extreme heat are the record highs and lows recorded between 1874 and 2013. Information provided by NOAA and Georgia Forestry Commission.

Bryan County

Bryan County is affected by the possibility of extreme drought due to the low precipitation levels throughout the county. Due to the coastal conditions the county has an unlikely chance of extreme cold but an occasional occurrence of extreme heat, as predicted by NOAA NOW Data. Flooding within this county is only likely due to a small amount of the county being within the flood plain. Hurricanes, sea level rise, and storm surges are still considered highly likely. Hurricanes are the most extreme and can become a category 5 hurricane while travelling up the county. The storm surges during a category 5 can reach up to 31 feet as predicted by NOAA. Sea level rise for this county can raise 6 feet as the extreme predicted by NOAA. Lightning is considered negligible due to its unpredictability and large extent. Wildfires are also considered limited due to their unpredictability in severity and location. According to the Georgia Forestry Commission, wildfires burned 405.6 acres between 2004 and 2013.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	Bryan	county wide, extensive	extreme	Likely	
Extreme Cold	Bryan	entire county, extensive	3*F, weak	unlikely	
Extreme Heat	Bryan	entire county, extensive	105*F, moderate	occasional	
Flood	Bryan	part of county, significant	severe	Likely	
Hurricane	Bryan	county wide, extensive	category 5, extreme	occasional	
Lightning	Bryan	negligible	weak to moderate	occasional	
Sea Level Rise	Bryan	county wide, extensive	6 ft, extreme	highly likely	
Storm Surge	Bryan	county wide, extensive	Category 5/ 31 ft, extreme	highly likely	
Wildfire	Bryan	parts of county, negligible	405.6 acres, weak	high in times of drought, likely	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.2. FEMA Hazard Summary Worksheet 5.1 for Bryan County. Extreme cold and extreme heat are the record highs and lows recorded between 1874 and 2013. Information provided by NOAA and Georgia Forestry Commission.

Liberty County

Liberty County is likely affected by extreme drought due to its low precipitation levels. Extreme cold is an unlikely occurrence due to warm coastal weather which also makes extreme heat an occasional occurrence. Like Bryan County, flooding in Liberty County is likely without the severity of the other counties due to a large part of the county not being within the flood plain. Hurricanes, sea level rise, and storm surges are highly likely within this area due to the large extent that all three disasters can affect. A category 5 hurricane can bring 31 feet storm surges as predicted by NOAA. Sea levels can rise up to 6 feet as the extreme predicted by NOAA. Lightning is considered negligible due to the unpredictability of events and severity. During times of drought lightning can cause wildfires. Between 2004 and 2013, the Georgia Forestry Commission recorded a total of 893.42 acres burned by wildfires.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	Liberty	county wide, extensive	extreme	Likely	
Extreme Cold	Liberty	entire county, extensive	3*F, weak	unlikely	
Extreme Heat	Liberty	entire county, extensive	105*F, moderate	occasional	
Flood	Liberty	part of county, significant	severe	highly likely	
Hurricane	Liberty	county wide, extensive	category 5, extreme	occasional	
Lightning	Liberty	negligible	weak to moderate	occasional	
Sea Level Rise	Liberty	county wide, extensive	6 ft, extreme	highly likely	
Storm Surge	Liberty	county wide, extensive	Category 5/ 31 ft, extreme	highly likely	
Wildfire	Liberty	parts of county, negligible	893.42 acres, weak to moderate	high in times of drought, likely	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.3. FEMA Hazard Summary Worksheet 5.1 for Liberty County. Extreme cold and extreme heat are the record highs and lows recorded between 1874 and 2013. Information provided by NOAA and Georgia Forestry Commission.

McIntosh County

McIntosh County can suffer from extreme drought due to the low precipitation levels of the region. Extreme cold is unlikely due to the position on the southeastern coast which makes extreme heat an occasional occurrence. Flooding is highly likely within this region due to large amounts of the county lying within the flood plain. Flooding can increase during hurricanes. Hurricanes at their most extreme can become a category 5 with 31 foot storm surges as predicted by NOAA. Sea level rise can cause a rise of a 6 feet at the extreme end as predicted by NOAA. Lightning is considered negligible due to the unpredictability and large extent that it can strike. Lightning can cause wildfires during times of extreme drought. McIntosh's wildfires burned 931.11 acres between 2004 and 2013 as reported by the Georgia Forestry Commission.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	McIntosh	County wide, extensive	Extreme	Likely	
Extreme Cold	McIntosh	Entire county, extensive	3*F, weak	Unlikely	
Extreme Heat	McIntosh	Entire county, extensive	105*F, moderate	Occasional	
Flood	McIntosh	Part of county, significant	Severe	Highly Likely	
Hurricane	McIntosh	County wide, extensive	Category 5	Occasional	
Lightning	McIntosh	Negligible	weak to moderate	Occasional	
Sea Level Rise	McIntosh	County wide, extensive	6 ft, extreme	Highly Likely	
Storm Surge	McIntosh	county wide, extensive	Category 5; 31 ft, extreme	Highly Likely	
Wildfire	McIntosh	parts of county, negligible	933.11 acres, severe	High in times of extreme drought, likely	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.4. FEMA Hazard Summary Worksheet 5.1 for McIntosh County. Extreme cold and extreme heat are the record highs and lows recorded between 1874 and 2013. Information provided by NOAA and Georgia Forestry Commission.

Glynn County

Glynn County has a likely risk of extreme drought due to the low precipitation the coastal region receives. This high levels of drought can increase the chances of wildfire which are considered as negligible. No data is available for the number of acres burned by wildfires. Lightning strikes are considered negligible due to the unpredictability of extent and extremity. Flood, hurricanes, storm surges, and sea level rise are highly likely and considered the most severe for this county. A category 5 hurricane can cause 31 foot storm surges as predicted by NOAA. These storm surges can cover most of the county with flooding. Sea level rise can have an extreme 6 foot rise as predicted by NOAA.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	Glynn	County wide, extensive	Extreme	Likely	
Extreme Cold	Glynn	Entire county, extensive	5*F, weak	Unlikely	
Extreme Heat	Glynn	Entire county, extensive	106*F, moderate	Occasional	
Flood	Glynn	Part of county, significant	Severe	Highly Likely	
Hurricane	Glynn	County wide, extensive	Category 5	Occasional	
Lightning	Glynn	Negligible	Weak to moderate	Occasional	
Sea Level Rise	Glynn	County wide, extensive	6 ft, extreme	Highly Likely	
Storm Surge	Glynn	county wide, extensive	Category 5, 31 ft extreme	Highly Likely	
Wildfire	Glynn	parts of county, negligible	No information available	High in times of extreme drought	

Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.5. FEMA Hazard Summary Worksheet 5.1 for Glynn County. Extreme cold and extreme heat are the record highs and lows recorded between 1874 and 2013. Information provided by NOAA and Georgia Forestry Commission.

Camden County

Camden County has a likelihood of drought due to the low precipitation for the region. During times of drought there is a high likelihood of wildfires. Specific wildfire acreage data is unavailable. Lightning strikes can cause wildfires but are considered negligible due to wide extent and unpredictability in area. Coastal position causes extreme cold to be unlikely but extreme heat is occasional as predicted by NOAA. A hurricane hitting this area can have severe repercussions with a category 5 hurricane carrying 31 foot storm surges as predicted by NOAA. Flooding is an extreme occurrence due to most of the county lying within the flood plain. Sea level rise can have a 6 foot extreme as predicted by NOAA.

Hazard	County	Location	Maximum Probable Extent	Probability of Future Events	Overall Ranking
Drought	Camden	County wide, extensive	Extreme	Likely	
Extreme Cold	Camden	Entire county, extensive	4*F, weak	Unlikely	
Extreme Heat	Camden	Entire county, extensive	104*F, moderate	Occasional	
Flood	Camden	Parts of county, significant	Severe	Highly Likely	
Hurricane	Camden	County wide, extensive	Category 5	Occasional	
Lightning	Camden	Negligible	Weak to moderate	Occasional	
Sea Level Rise	Camden	County wide, extensive	6 ft, extreme	Highly Likely	
Storm Surge	Camden	County wide, extensive	Category 5, 31 ft, extreme	Highly Likely	
Wildfire	Camden	Parts of county, negligible	No information available	High in times of extreme drought	

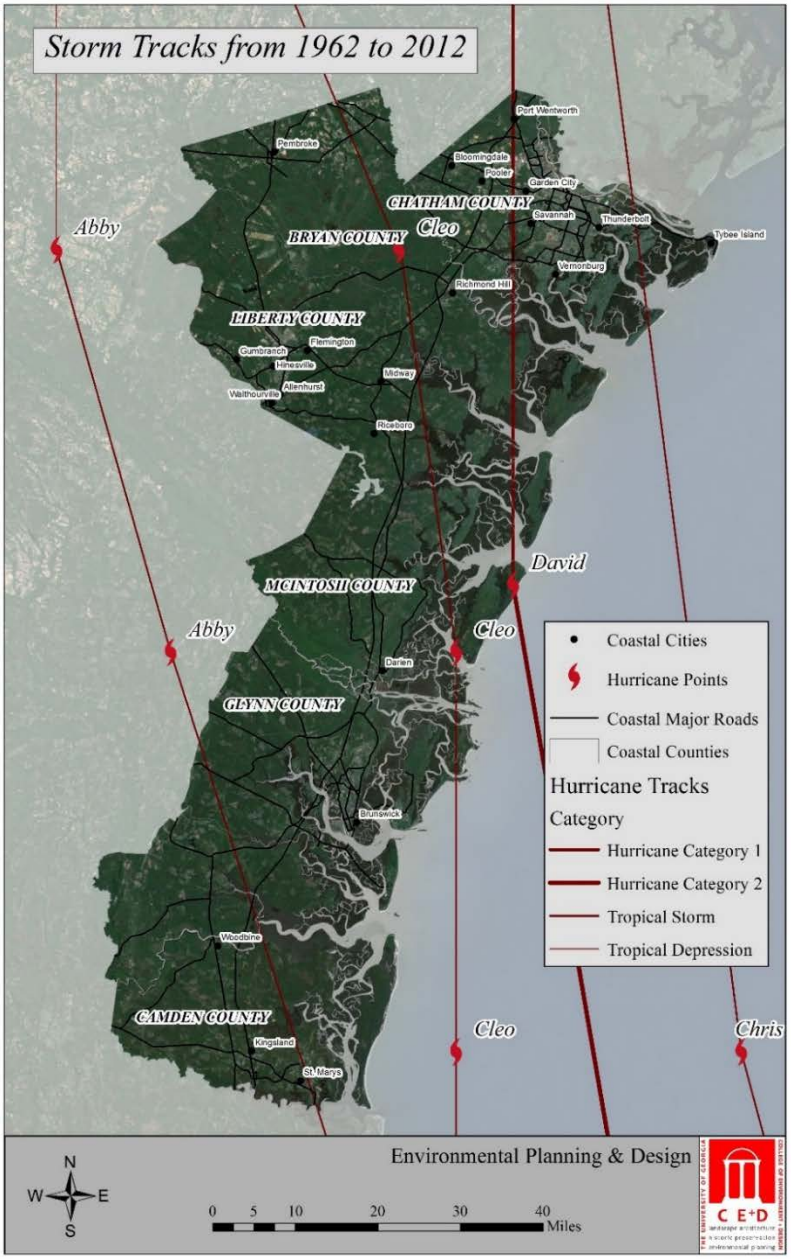
Ranking Color Code

- highly likely, covers a large extent, results in severe damage lasting weeks to months
- likely, covers a large to moderate extent, results in damage that can be severe, lasts weeks
- occasional to likely, covers a moderate extent, results in damage lasting days to weeks
- limited, covers a small extent, damages lasts hours to days
- negligible, covers a random small extent, damage is hit or miss in severity

Table 1.1.6. FEMA Hazard Summary Worksheet 5.1 for Camden County. Extreme cold and extreme heat are the record highs and lows recorded between 1874 and 2013. Information provided by NOAA and Georgia Forestry Commission.

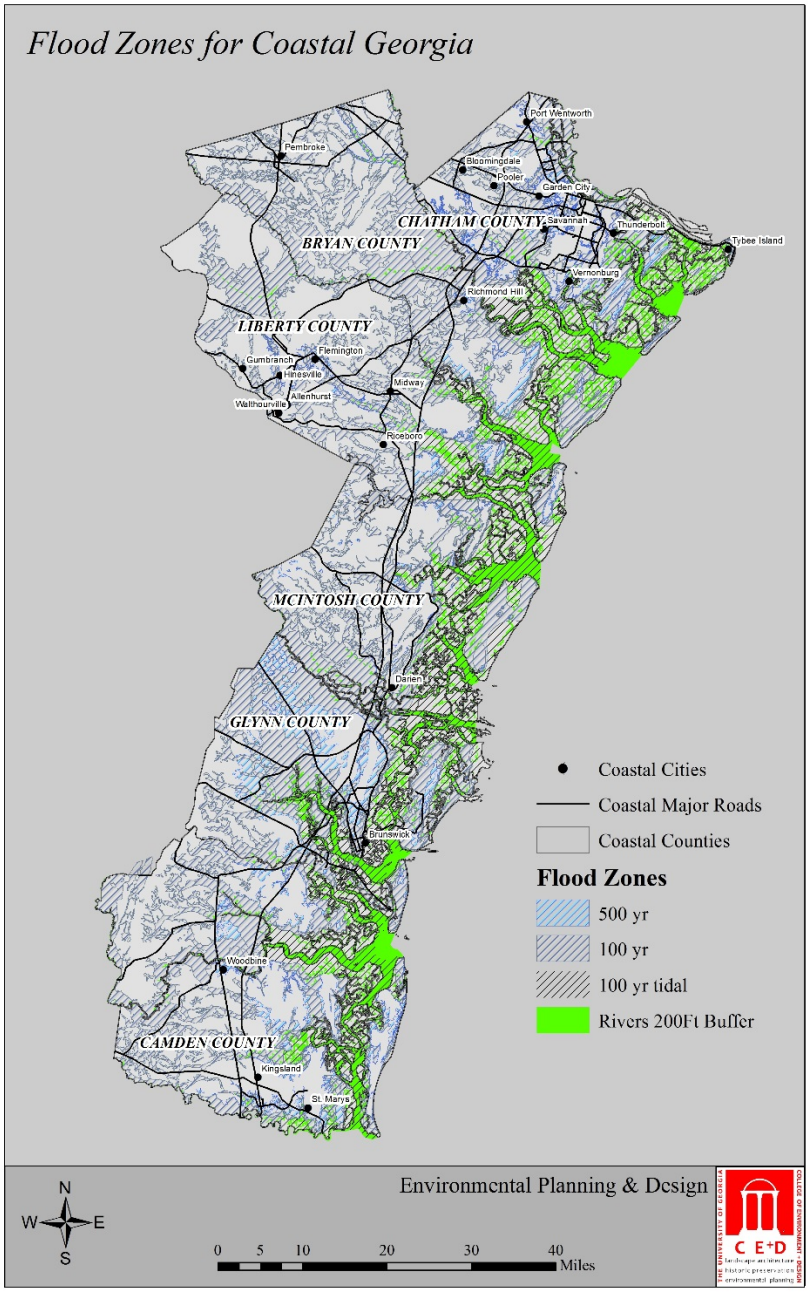
Maps

The storm track map (Map 1.1.1) shows historical storms which made landfall on Georgia's coast for the last fifty hurricane seasons. It is used to gain an idea of the most vulnerable areas based on past landfalls. As shown below, St. Mary's, Savannah, and Brunswick were all in the path of previous storms. When looking at this map, keep in mind that these four storms were all small and landfall locations may change over time. David was the largest: making landfall as a category one hurricane.



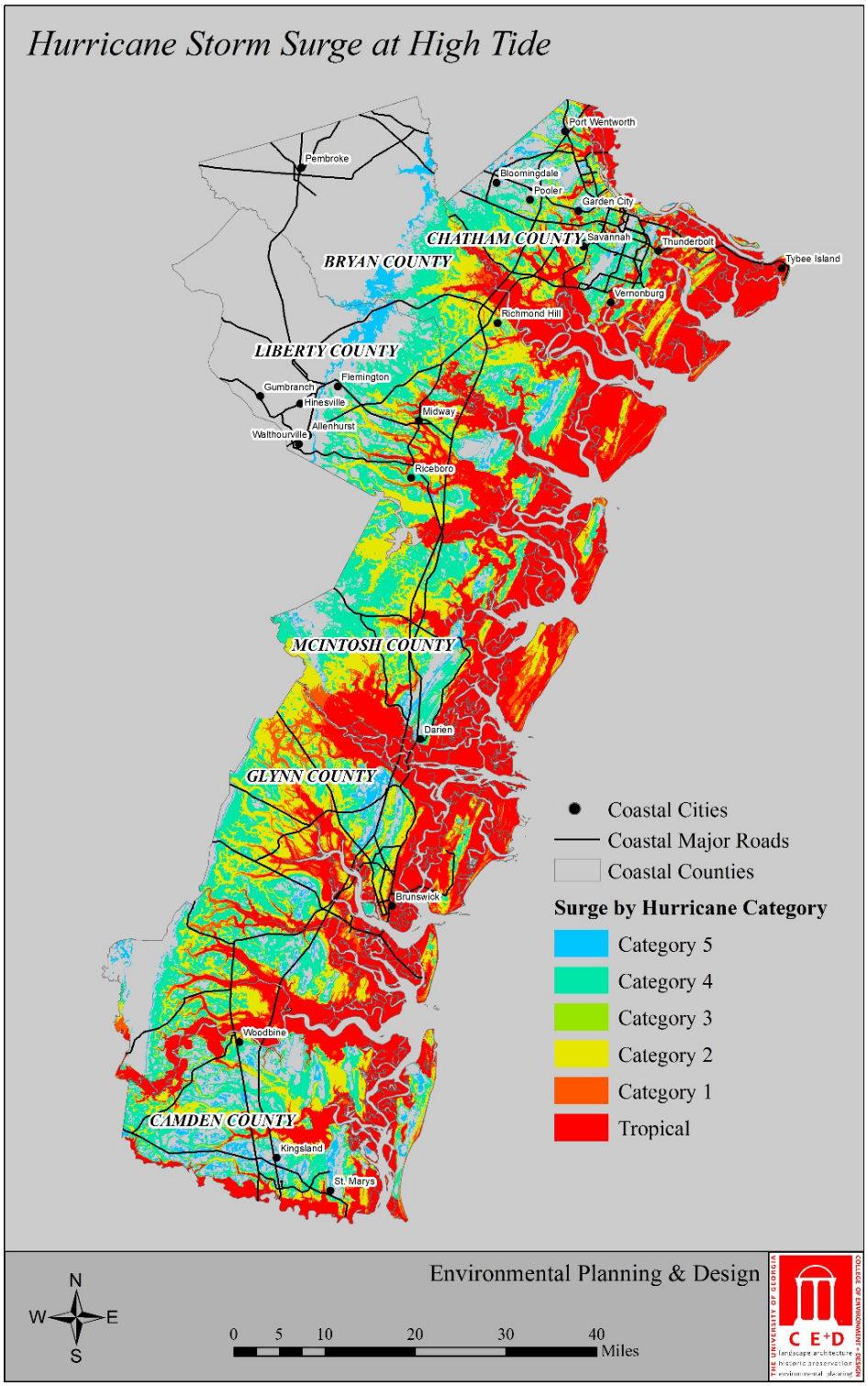
Map 1.1.1. Hurricanes between 1962 and 2012 that made landfill on Georgia's coast. The paths displayed follow the center of the storm. This does not include hurricanes that moved across Florida and the Carolinas to strike Georgia. Information provided by NOAA.

Map 1.1.2 displays floodplains for Georgia's six coastal counties, with the 100 year floodplain, and the area's most vulnerable to tidal flooding along with the 500 year floodplain. A 200 foot river buffer is also shown. This is based on the maximum recommended riparian area need for flood control by the "UGA Guidelines for Coastal Georgia Riparian Buffer Restoration" document created for Georgia's Department of Natural Resources. All of these areas need to be considered when looking at vulnerable areas to flooding resulting from storm surges.



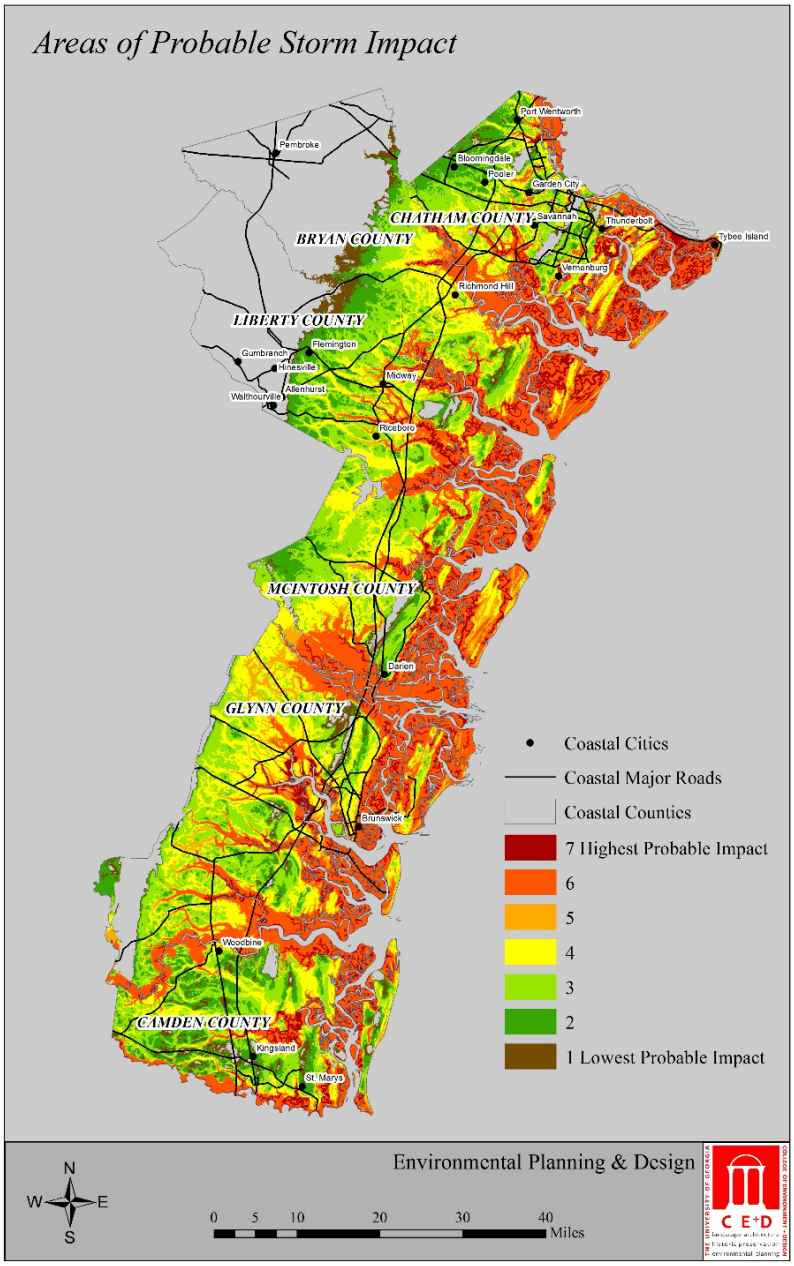
Map 1.1.2. Coastal Georgia floodplains with 200 foot river buffer. Information provided by FEMA, Georgia DNR, and US Fish & Wildlife Service.

The Storm Surge map (Map 1.1.3) shows predicted flooding due to storm surges from a tropical storm through a category 5 hurricane. The storm surges were determined by NOAA using the SLOSH model



Map 1.1.3. Predicted storm surge when a storm makes landfall at high tide. Information provided by NOAA.

The Probable Storm Impact Area (Map 1.1.4) combines the floodplain, storm surge, and river buffer maps shown above. In general, those areas closest to the rivers and coast were determined to be areas of highest probable impact while areas farthest from the coast are considered areas of lowest probable impact. An adaptation of this map was used to determine which areas in the built environment should be targeted for flood and storm resilience planning. When data becomes available, the map should be updated with sea level rise predictions to determine the most vulnerable areas under this category.



Map 1.1.4. Areas and their probable impact from storm damage. Information provided by NOAA, FEMA, DNR, and US Fish & Wildlife.

Conclusion

Due to the extent of flooding caused from storm surges and sea level rise, looking at where natural disasters are predominant does not offer enough information on the most vulnerable areas. Areas most affected will be the closest to the ocean and surrounding all five major rivers (Altamaha, Savannah, Ogeechee, Satilla, and St. Mary's). Glynn County is especially vulnerable and special attention will need to be made. Overlaying the natural disaster information with knowledge of cities, population dynamics, businesses, and vulnerable wildlife will allow for a better idea of where these vulnerable areas are and how to best plan for their sustainability and resilience. The sections following this chapter will look in depth at each of these issues and offer recommendations on how to best increase resilience.

1.2 Natural Environment

Introduction

Georgia's natural coastal landscape can be traced back to the melting of the continental glaciers. The rivers brought down thousands of years' worth of sediment, sand, and soil to the coast. This sediment initiated ridges and dunes that created Georgia's barrier islands. The water that formed behind the barrier islands shaped the vast marshland that we know today. Spartina grass (*Spartina alterniflora*) still covers much of the coastal marsh area of Georgia and thrives on its ability to remove most of the salt out of the water as well as surviving Georgia's constant fluctuation of tides.

Georgia tides represent a vital process for the marshal ecosystem. Incoming tides provide food for the grasses of the marsh while the outgoing tides carry food and nutrients produced by the marsh to the sea. The blending of these two water sources provides critical habitat for fish, turtles, birds, mammals and the fisheries of Georgia. Seventy percent of Georgia's fish, shrimp, crabs, and shellfish spend a portion of their life in the estuarine waters of the salt marshes. These estuaries are nutrient driven by tidal waters which average 6.5 feet twice a day. During king tides these tides can average 10 feet.

Maritime dunes lie landward of the coastal beaches and seaward of the maritime forests. The dunes closest to the beach are vegetated by salt-tolerant and sand-holding species that provide nesting or foraging habitat for a variety of animals, such as loggerhead and leatherback turtles. Maritime dunes are among the most picturesque and heavily visited environments of the coastal region; protecting their economic value depends on also conserving their ecological values. Sand sharing, sediment transport, and long shore current are natural processes that sustain maritime dunes. Limiting coastal development, channelization of coastal rivers, upstream impoundment, and seawall/jetty construction can protect them from interfering with the natural movement of sand, sediments, and currents.

Additionally the wetlands, marshes, and riparian zones act as buffers against offshore storms. The vegetation has a dissipating effect on wave intensity. Hurricanes and storm surges would have larger negative impacts to infrastructure if there were no natural marshes and vegetation. Management of salt marshes, wetlands, and riparian zones should be integrated into coastal hazard mitigation plans and sea level rise adaptation policies. The assessment, synthesis, and proposals for the regional coastal plan include the following natural features: hydrology, wetlands and riparian zones, water recharge areas, critical vegetation habitats, areas of development/disturbance, and conservation land.

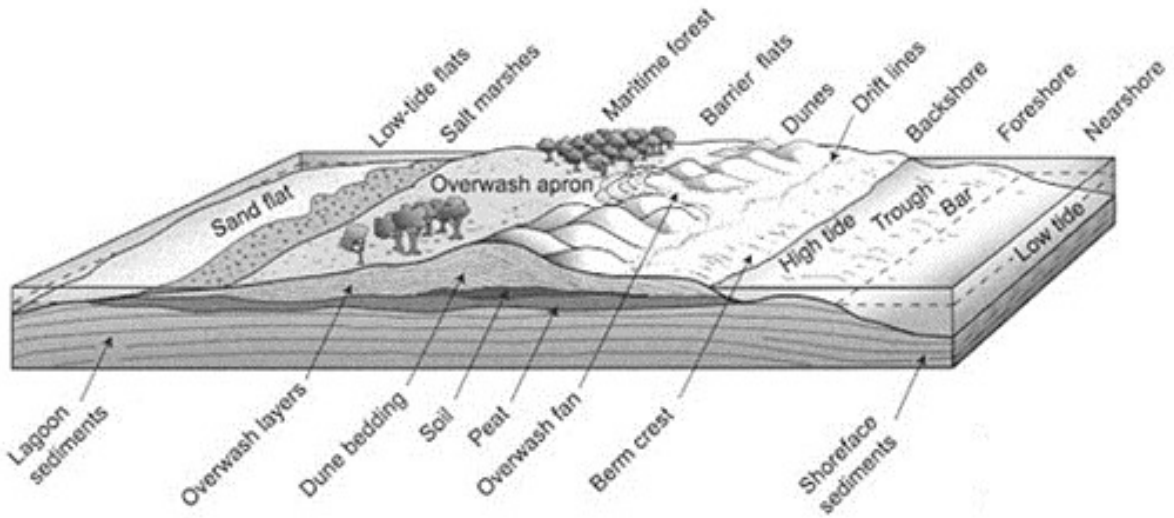


Figure 1.2.1. Cross-section of a typical barrier island. Adapted from work by Paul Godfrey; drawing by Charles Pilkey.

Problem Statement

Coastal Georgia has vast amounts of environmental assets and natural resources. These features are significant to the quality of life and they help support the economy through tourism & recreation, agriculture, and a variety of other ecosystem services. The natural environment also provides important protective functions that reduce storm hazards and increase resiliency. One key example is how wetlands and riparian vegetation help absorb floodwater. Another way the natural environment increases resiliency is through soils and landscaping which contribute to storm water management, provide erosion control, and reduce run-off. Opportunities to meet mitigation and other community objectives can be fulfilled by conservation of critical or sensitive habitats.

Problem Statements:

- Identify the most valuable areas that provide protective functions that reduce the magnitude of hazardous events (wetlands, vegetation buffers, and development/disturbance).
- Identify critical habitat areas and other environmental features that are important to protect.

Through identification of valuable and critical areas other key natural features and processes are addressed indirectly including: soil and erosion, storm water runoff, and continuous wildlife corridors.

Methods

1) List current conditions, collect data, and develop maps for further synthesis.
   - Wetlands
   - Water recharge areas
   - Hydrology
   - Developed/distributed vs. natural land cover by inundation zones (storm surge)
   - Developed/distributed vs. natural land cover by buffer.
   - Rare species and critical habitat (G_Rank as utilized by GDNR) and conservation areas.

2) Create riparian buffer recommendations base upon literature review.

3) Create tables and graphs for further analysis.
   - Percent vegetation within each buffer zone
   - Percent develop within 200' buffer
   - Percent Developed Land Within Inundation Zones
     - Percent Impervious to Natural space within the 6 inundation zones and riparian buffers: Using DNR vegetation data, we were able to calculate basic percentages of Natural vs. developed land within each inundation zone, or riparian buffer. By doing this, we were able to discern how much developed land each county had within each area

Assessment

Storm surge and development

There is a low area of developed land within the tropical storm surge zones at less than 10%. Inundation zone (also referred to as storm surge zone) 1 shows that Glynn County has the most coverage of developmental area, approximately 15%. All other counties reveal that development is below 10% within the storm surge zone 1. Storm surge zone 2 shows that the percent of developed land increases. Camden, Chatham, and McIntosh contain 20% - 30% of developed land and Glynn County contains 40% development. Chatham and McIntosh show an increase in development at 30% for storm surge zone 3. The other counties during storm surge zone 3 are 15% - 25% developed. In inundation zone 4, the development coverage decreases to fewer than 20%. In inundation zone 5, the development coverage is equal to or less than 10%. Based on this, the tropical storm and inundation 1 zone should limit development. The inundation zone 2 and 3 has the most developmental coverage that should be considered in the plan as represented by Figure 1.2.2.

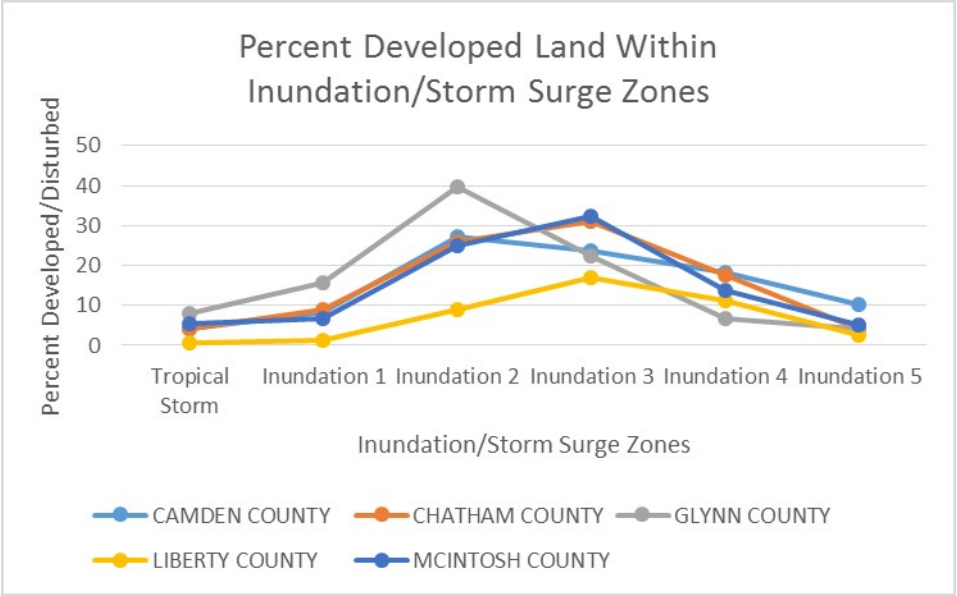


Figure 1.2.2. Developed/disturbed land is defined as clear-cut, developed, power line/pipeline, quarry/strip-mine, and transportation by the DNR vegetation layer attribute table. Data derived from GIS vegetation and storm surge data provided by NOAA and Georgia DNR. Bryan County is not included because there is no vegetation data provided.

Vegetation/open water buffers

Riparian buffers can be given a value or rank based on their presence and extension from open water and wetlands towards the built and developed environment. Three categories are of consideration: 100, 150, and 200-foot riparian buffers. A 100-foot riparian buffer is the recommended minimum based on literature reviews by the scientific community. As reported by the U.S. Agriculture and U.S. Environmental Protection agency in 1997, there are specific riparian widths that are associated with specific objectives. The recommended buffer width for flood control should be up 200 feet. This buffer width provides flood and sediment control as well as wildlife habitat.

Buffers narrower than 35 feet can provide some limited benefits but may require long-term maintenance since their ability to trap sediments is reduced (Giovengo, 2012). Currently, **The Soil Erosion and Sedimentation Act of Georgia** sets minimum standards for land-disturbing activities that counties must enforce. Counties and municipalities must adopt comprehensive ordinances that establish procedures for controlling land-disturbing activities. One requirement is the installation of best management practices that avoid soil erosion caused by storm water runoff. Another aspect of the act requires that no land-disturbing activities be undertaken within 25 feet from state waters. *This buffer needs to be extended*:

> Seth Wenger states, “To provide maximum protection from floods and maximum storage of flood waters, a buffer should include the entire floodplain. Short of this, the buffer should be as wide as possible and include all adjacent wetlands. (1999).”

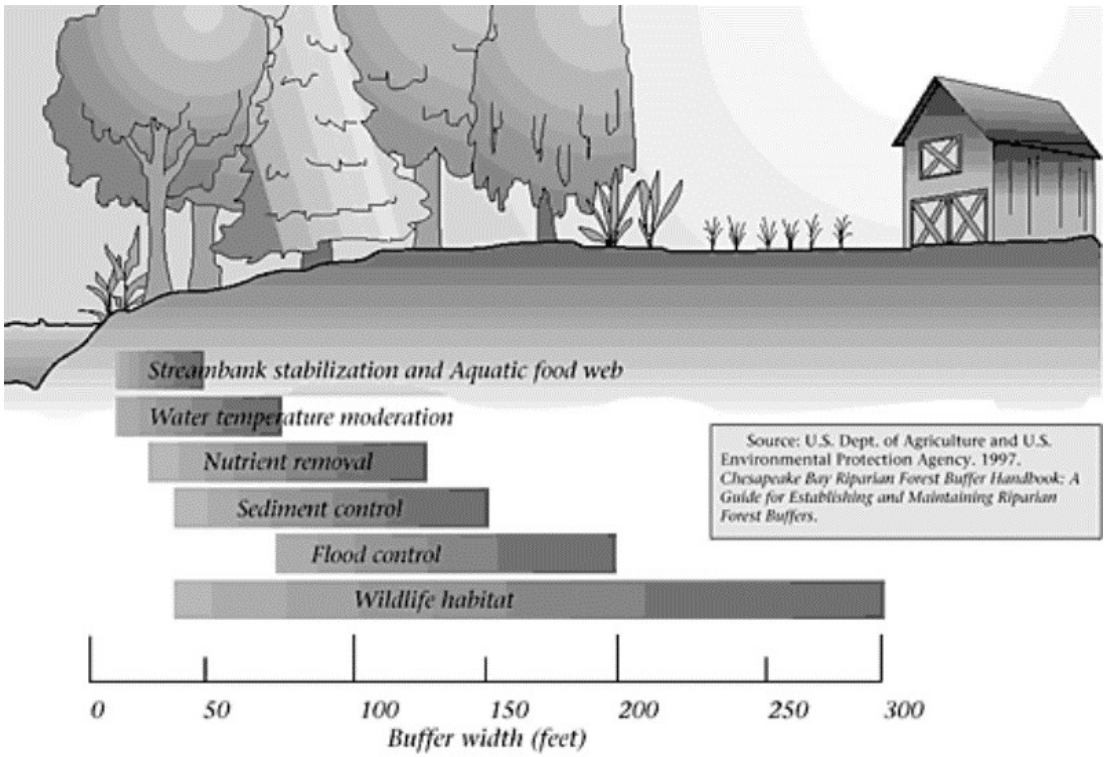


Figure 1.2.3. Buffer widths (in feet) for specific objectives. Information provided by Giovengo 2012.

The five counties have about 90% vegetation within the 100-foot riparian buffer. Within the 150-foot riparian buffer the vegetation coverage decreases slightly. The largest decrease in vegetation is within Glynn and Chatham Counties that declines from around 80% to 70% and 70% to 60%. McIntosh and Liberty County's vegetation coverage does not change drastically, staying between 90% and 80%. This represents the effects of development and the importance of maintaining buffers on the riparian zone for protection of vegetation and hydrology. The expanding built environment continues to threaten the natural environment. The state currently mandates a 25-foot buffer from hydrology, which is inadequate for protecting the vital natural system as represented by Figure 1.2.4.

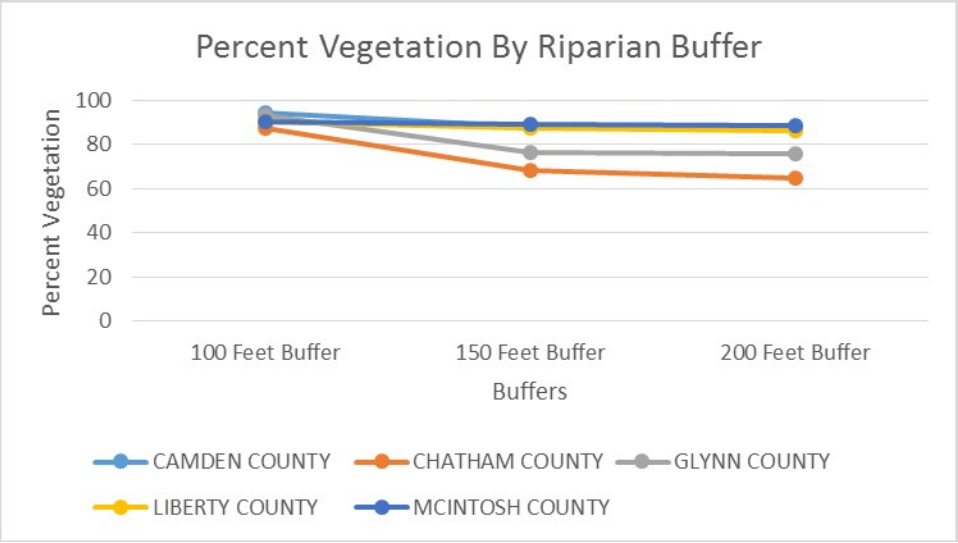


Figure 1.2.4. Percent vegetation within each proposed riparian buffer for five coastal counties. As you move away from open water and wetland the percent vegetation decreases. Data derived from GIS vegetation data provided by DNR. Bryan County is not included because there is no vegetation data provided.

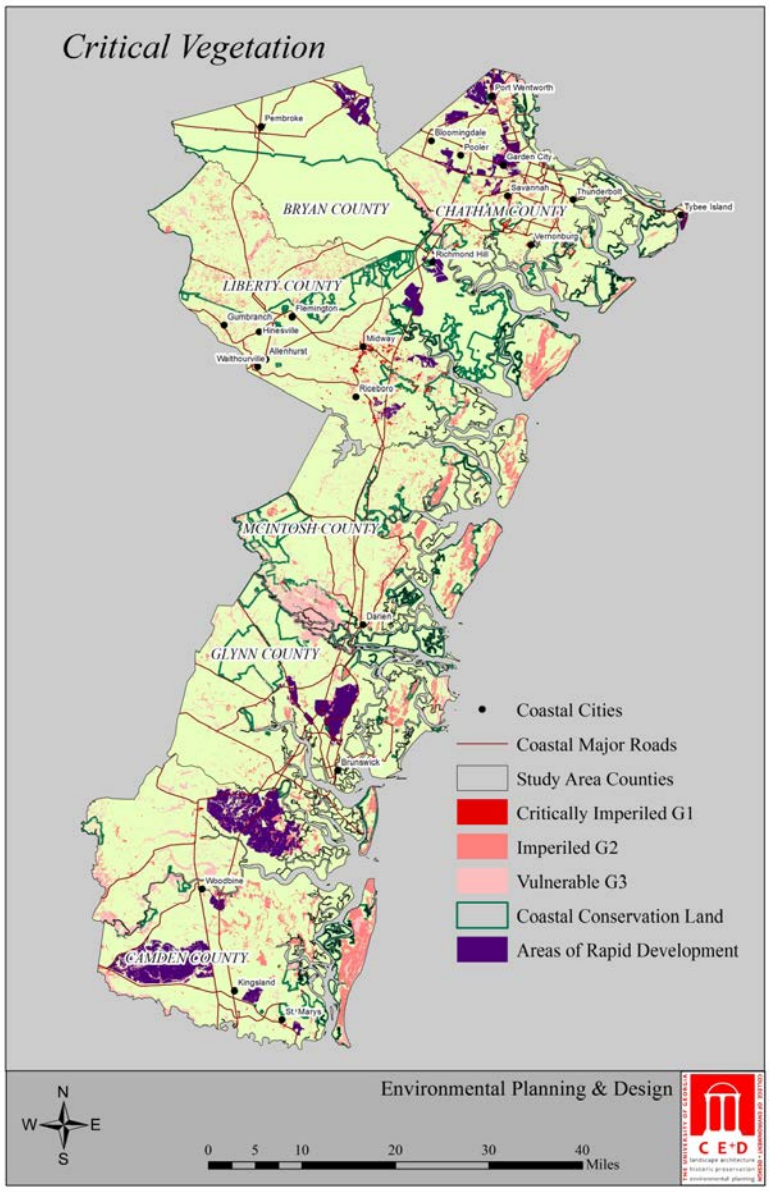
Table 1.2.1 shows the percent of developed and rapidly developing land within the 200-foot buffer. The information used to define rapidly developed areas was previously created and defined by the Coastal Regional Commission in The Coastal Regional Plan. The rapidly developed areas relate to what the CRC has defined as areas where rapid development or change of land uses are likely to occur. These areas tend to be where the rate of development has and/or may outpace the availability of community facilities and services, including transportation. When examining the percent developed/disturbed land, Chatham County (25.86%) and Glynn County (20.27%) have more developed area than the other counties while McIntosh (8.34%) has the least development/disturbed percentage. McIntosh has no rapid development area. Camden and Chatham County have relatively more rapidly developing areas within the 200-foot buffer than others at 19.84% and 5.50% respectively. Overall, Camden, Chatham and Glynn County should limit their speed of development within the 200-foot buffer.

Counties	Percent Developed within 200 Foot Buffer	Percent Rapid Development within 200 Foot Buffer
Camden	10.09%	19.84%
Chatham	25.86%	5.50%
Glynn	20.27%	2.96%
Liberty	10.56%	0.26%
McIntosh	8.34%	0.00%

Table 1.2.1. The percent of developed/disturbed and rapidly developing area within the 200-foot buffer. Considerations of limiting growth and sprawl are recommended. Information derived from Georgia DNR GIS data.

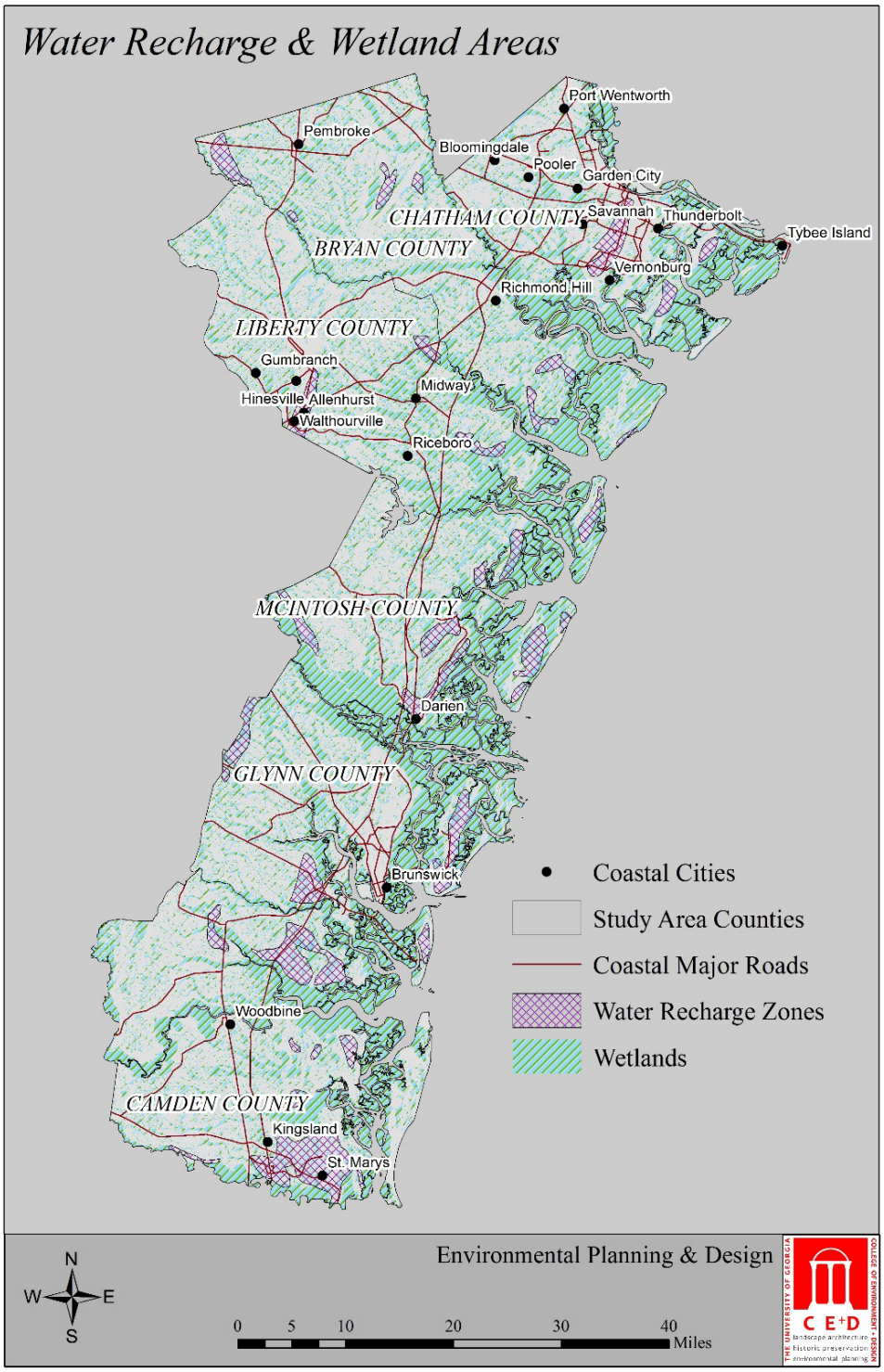
Maps

The Critical Vegetation Map below identifies locations and areas of sensitive habitat. The G_RANK is an indication of vegetative imperilment. There are three vegetation types of interest for our study: G1 - Critically Imperiled, G2 – Imperiled, and G3 – Vulnerable. The critical vegetation map references areas of rapid development and conservation. Rapid development areas are locations of interest due to human impact on vegetation types. Conservation areas demonstrate locations that are areas of interest due to the potential of providing protection to these critical habitats.



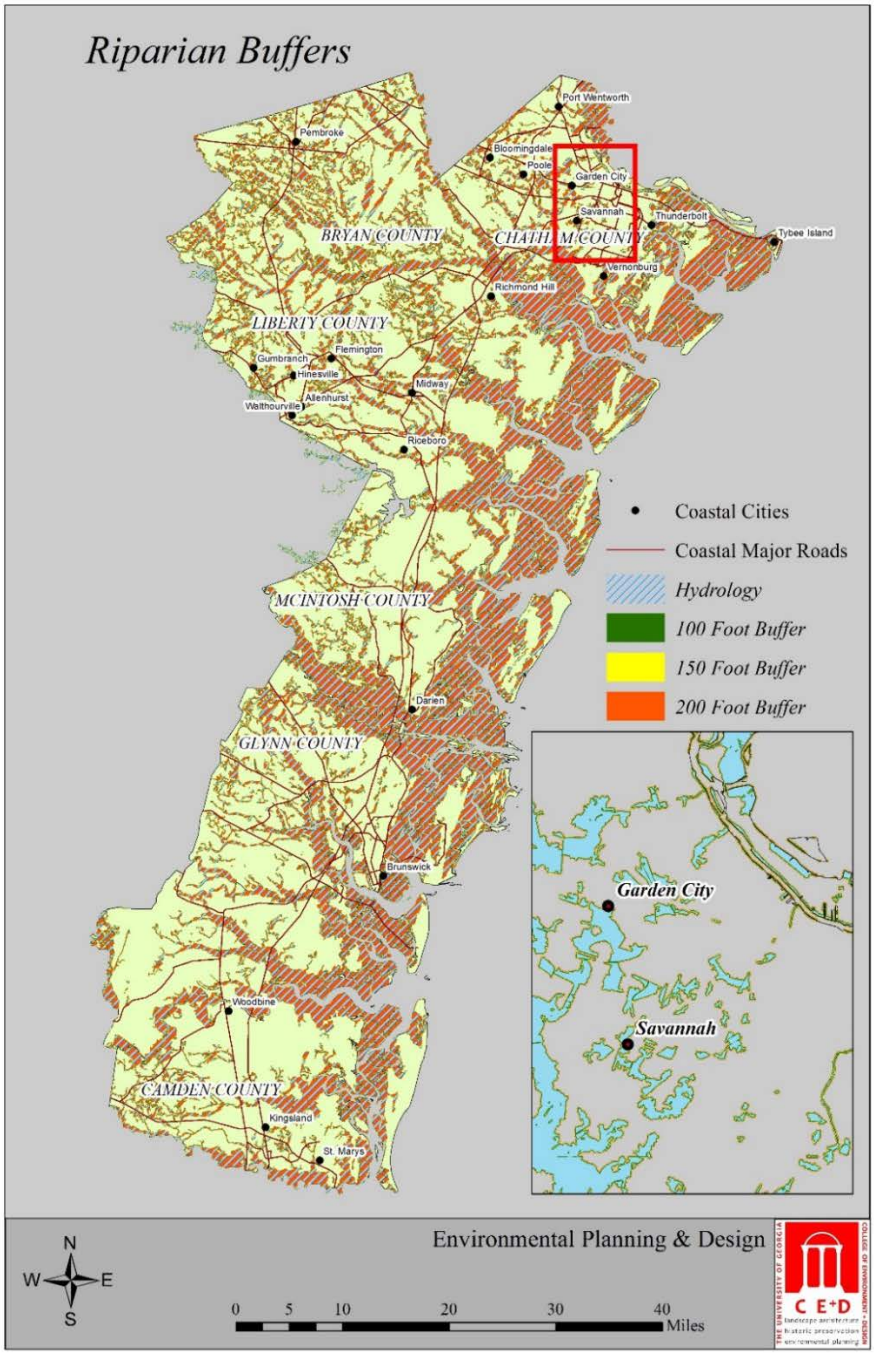
Map 1.2.1. Critical Vegetation Areas. Note that the Areas of Rapid development were created before the 2008 market crash and therefore may not be accurate. Information provided by Georgia DNR.

Map 1.2.2 identifies current locations of water recharge areas and wetlands. Wetland areas help maintain ground water recharge. Wetland protection within the recharge zones is recommended for the stability of groundwater volume.



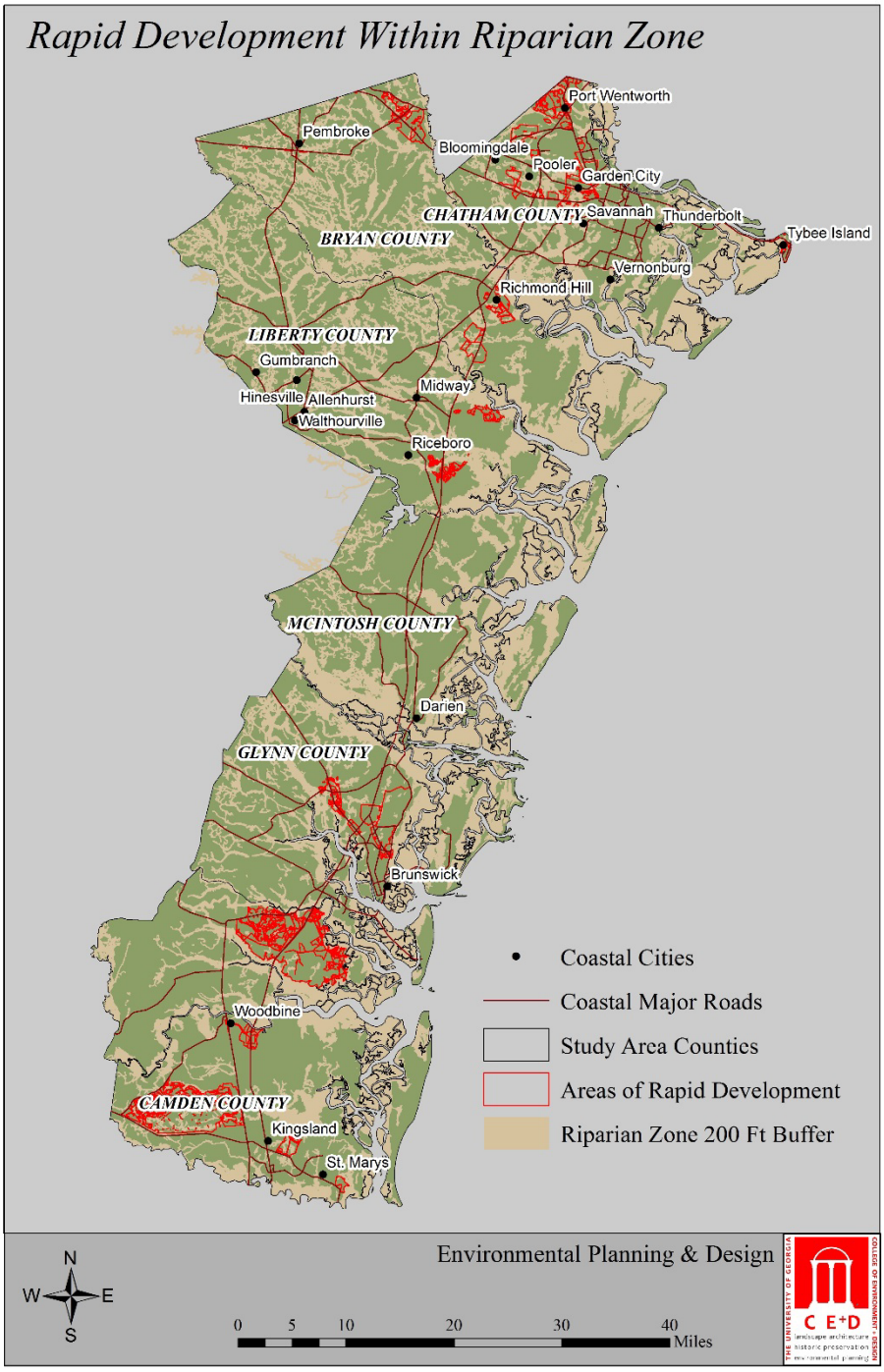
Map 1.2.2. Wetland and Water Recharge Areas. Information provided by Georgia DNR.

The Riparian Buffer map (Map 1.2.3) identifies buffers around open water and wetlands. These hydrological features are extensive enough to be included in all riparian buffers and are representative of the flood plain and marshlands along the coast. Three categories of consideration are: 100 foot, 150 foot and 200 foot. Increasing riparian width and percent vegetation within these areas have shown to be of benefit during flooding and/or storm surge events.



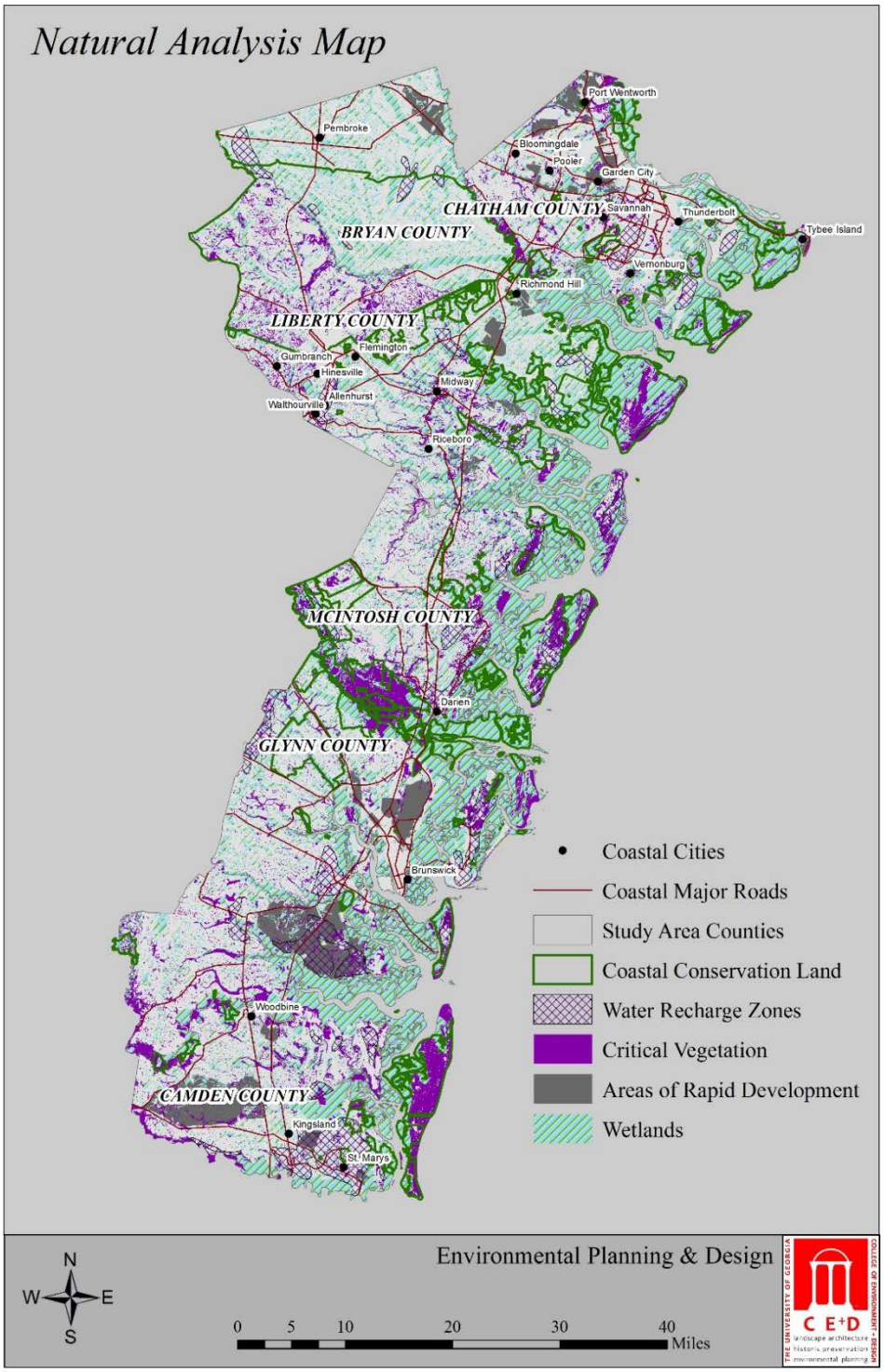
Map 1.2.3. Riparian Buffers. Map inset shows details of riparian buffers around wetlands and other water bodies near Savannah. Information provided by Georgia DNR.

Map 1.2.4 shows areas of rapid development pattern that abuts or overlaps with a 200-foot buffer. The map highlights areas of interest in regards to the future protection of vegetation within these buffers. Areas of rapid development should be considered for future mitigation or modifications to planning policies for development patterns around riparian zones.



Map 1.2.4. The identified areas of future rapid development may have changed since they were created in 2008. Information provided by Georgia DNR.

The Natural Analysis **(Map 1.2.5)** is descriptive of current natural conditions. The location and distribution of existing conservation land, water recharge zone, critical vegetation, wetlands and rapid developing areas are represented.



Map 1.2.5. This map can be referenced in developing limitations on growth and development. Information provided by Georgia DNR.

1.3 Social and Economic

Demographics

According to the 2010 Census, there are over five hundred twenty-five thousand people in the coastal region. Of these Chatham accounts for almost half of this population with a population count of two hundred and seventy-nine thousand. Glynn is the next most populous county with eighty-one thousand people. Liberty, Camden, and Bryan account for sixty-seven thousand, fifty-thousand, and thirty-two thousand respectively. McIntosh County accounts for the least populous county with a scant thirteen thousand people. Overall, this represents about six percent of the total population of Georgia (Claritas Nielsen, 2013).

	Total Population	Percent of Total Georgia Population	2013 Estimate Households	Percent of Total Georgia Households
Georgia	**9,919,945**	100.00%	**4,102,992**	100.00%
Bryan	32,729	0.33%	11,684	0.28%
Camden	50,262	0.51%	18,129	0.44%
Chatham	279,103	2.81%	109,067	2.66%
Glynn	81,258	0.82%	32,374	0.79%
Liberty	67,801	0.68%	24,026	0.59%
McIntosh	13,970	0.14%	5,888	0.14%

Table 1.3.1. County Populations and Households of Coastal Georgia. Information derived from Claritas Nielsen. (2013). Population Quick Facts [Data file].

According to the state of Georgia, over the next twenty years, the population of the region is projected to increase by about one hundred fifty-thousand people in the coastal region. Camden County is expected to see the largest gain at 26%. Bryan is a close second with a 25% expected increase in population. All counties in the study area are expected to see increase in their population of over 15% (Governor's Office of Budget and Planning, 2012).

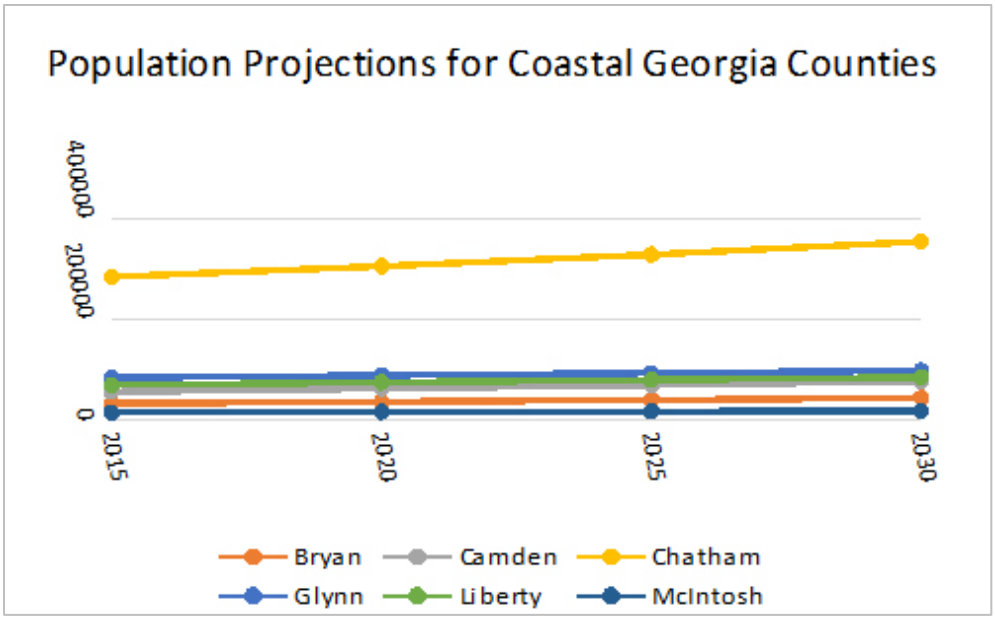


Figure 1.3.1. Population Trend for Coastal Georgia Counties. Information derived from Governor's Office of Planning and Budget, (2012). Georgia Residential Population Projections: 2010-2013 [Data file].

In terms of racial breakout, in coastal Georgia those of Caucasian descent account for fifty-eight percent of the total population. The next largest racial group, African Americans constitute thirty-four percent of the total population of the coastal region. The remaining eight percent is divided up among Asians, Native Americans, as well as non-specific and multiracial identities. Ethnographically speaking, non-Hispanics constitute a majority of the population (94%). Hispanics account for only six percent of the population of coastal Georgia (Claritas Nielsen, 2013).

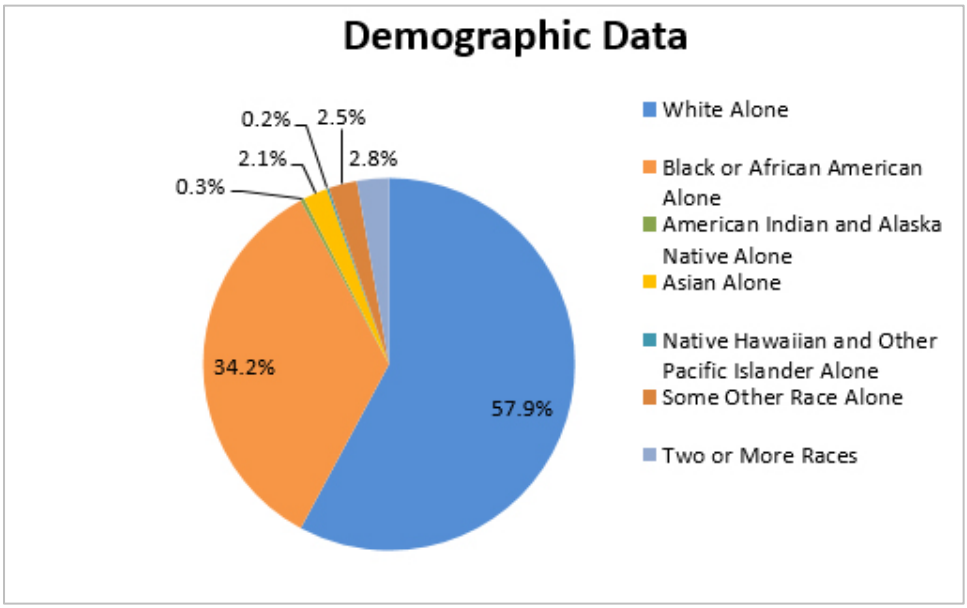


Figure 1.3.2. Demographic Data for Coastal Georgia Region. Information derived from Claritas Nielsen. (2013). *Demographic Snapshot (Part 1)* [Data file].

The coastal Georgia region is fairly well educated. About eighty-seven percent of the population has earned a high school degree or higher. About thirty-four percent of the population has earned a Bachelor's degree or higher. Twelve percent of the population of the region has failed to complete high school or, in some cases, has little to no education.

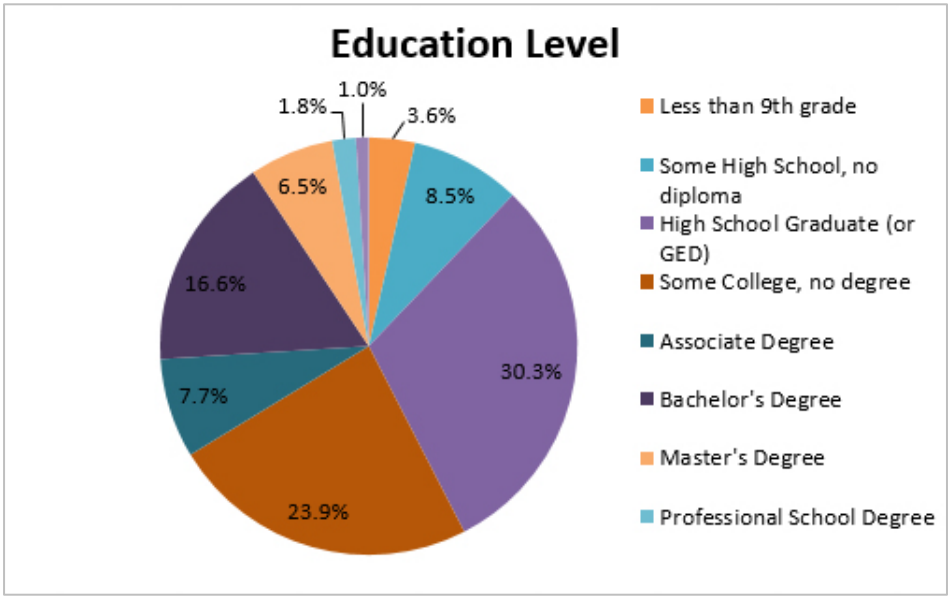


Figure 1.3.3. Education Level for Coastal Georgia Region. Information derived from Claritas Nielsen. (2013). *Demographic Snapshot (Part 1)* [Data file].

It is important to consider the oldest and least mobile citizen in a place when attempting to qualify a region. The highest concentration of people over the age of eighty-five can be found in Chatham County. According to the 2010 census, there were almost five thousand people residing in this county who were over the age of 85. In total, there are about seventy-five hundred people in the region who have celebrated more than eight-decades on the planet (Claritas Neilsen, 2013).

Housing Assessment

According to the most recent census (2010), there were a total of over two hundred thousand households in the coastal Georgia region. In context of the state, that accounts for about five percent of all Georgia households. Of the counties counted in this study, Chatham accounted for the lion's share of these households with about one hundred and nine thousand households. Glynn accounted for thirty-two thousand households. Liberty counted almost sixty-eight thousand households. The final three counties; Camden, Bryan, and McIntosh, accounted for fifty-thousand, thirty-three thousand and thirteen thousand households respectively. These numbers match up fairly well when considering the population distribution in the region (see Table 1.3.1 above).

Overall, the region is fairly poor in terms of household income. Thirty percent of the population earns less than twenty-five thousand dollars per year. Almost half of all households are living on less than thirty-five thousand dollars per year.

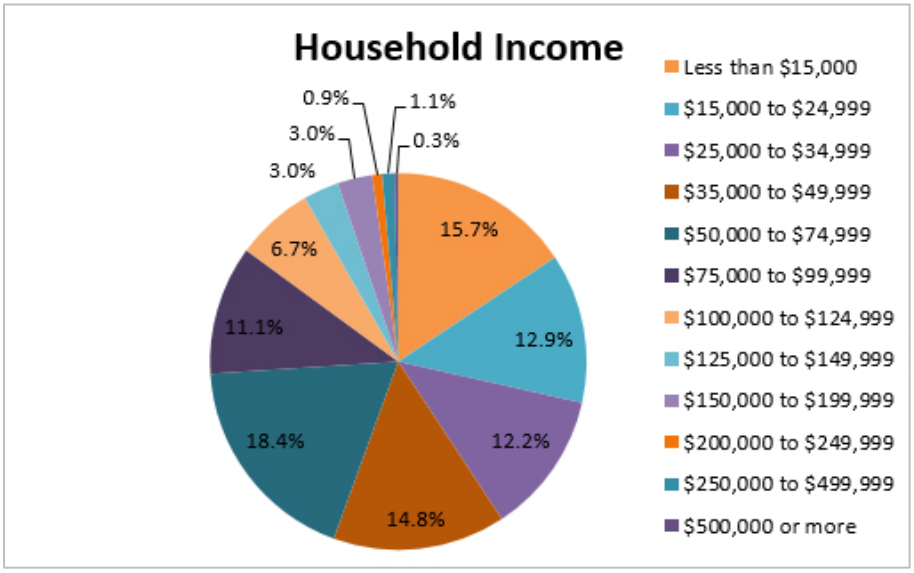


Figure 1.3.4. Household Income for Coastal Georgia Region. Information provided by Claritas Nielsen. (2013). *PopFacts: Demographic Quickfacts* [Data file].

Occupational Assessment

The coastal Georgia region has a very diverse economy that can be analyzed by looking at the distribution of jobs in the region. A little over half of all jobs (56%) fall into the white collar category. Blue collar jobs account for 26% of all jobs. Agriculture makes up the final 18% of all jobs in the region.

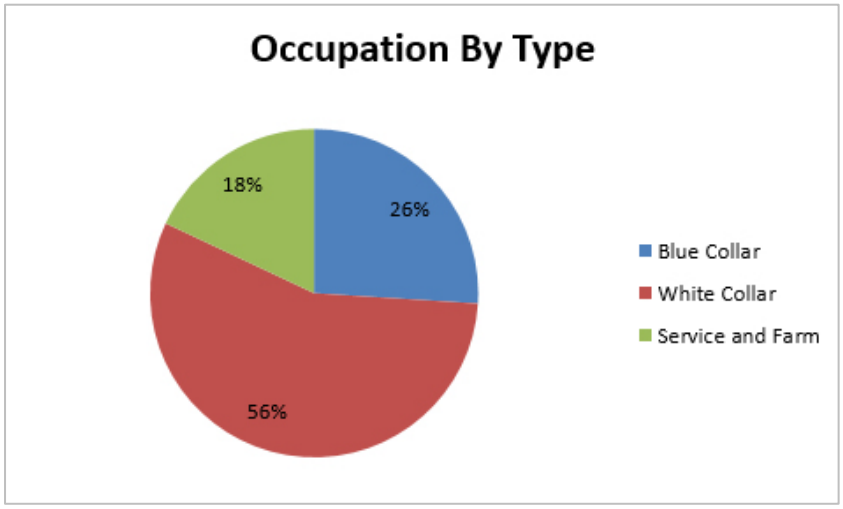


Figure 1.3.5. Occupational Data for Coastal Georgia. Information provided by Claritas Nielsen. (2013). *Demographic Snapshot (Part 1)* [Data file].

A more in depth analysis of the economy demonstrates that much of the region is involved in many diverse industries. At the regional level, there is no one dominating vocation for the region, but there are a few that stand out. Office and Administration is a major industry accounting for about fifteen percent with sales related jobs following with about eight percent of all occupations in the region. Management (farms included), education, and personal care services constitute the next tier of major industries ranking in about seven percent each. The lack of any dominate occupation in the region is representative of how complex and diverse the economy of the region is (Claritas Nielsen, 2013).

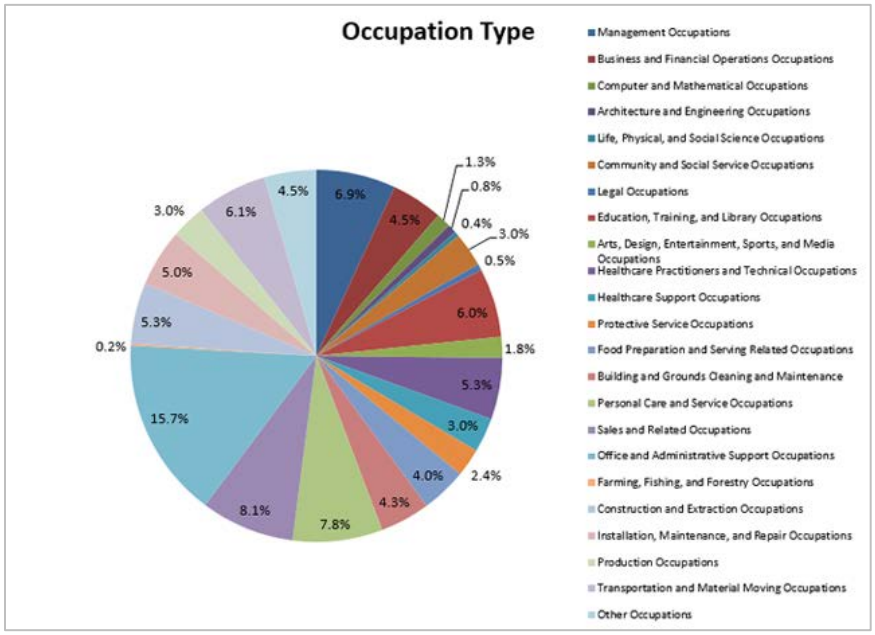


Figure 1.3.6. Occupational Data for Coastal Georgia. Information provided by Claritas Neilsen. (2013). *Business Summary: Occupation (Part 1)* [Data file].

Macro Level Business Data and Survey of Major Industries

The business data was taken in aggregate for the region. There are approximately $55 billion dollars for the total returns in sales for the whole region. This represented an estimate of 28,718 businesses and 279,484 jobs.

	Number of Businesses	Annual Sales ($000s)	Employees
Coastal Region	**28,718**	**55,462,232**	**279,484**
Bryan	1,379	2,317,441	9,438
Camden	2,155	2,704,402	5,643
Chatham	16,417	36,046,305	161,241
Glynn	5,874	10,396,041	60,287
Liberty	2,300	3,110,639	38,961
McIntosh	593	887,404	3,914

Table 1.3.2. Coastal Georgia Business Facts by County 2013. Information provided by Claritas Nielsen (2013). *Business Facts 2013* (Part 1) [Data file].

Fishing

Fishing is a small portion of Georgia's total economy. The industry has been on the decline since imported shrimp entered the market in the late 1990s. Shrimp, crabs, and oysters account for the principal cash crops of this industry. Shrimp fishing is still an important aspect of the economy for the region. Brunswick was once called the" shrimp capital of the world".

Shipping and Receiving

There is a long history of shipping and receiving in the coastal region. Savannah and Brunswick are both busy ports in America. Savannah accounts for the second busiest port in the country, recently surpassing Charleston. Plans to dredge the port in order to allow for the larger Panamax ships will further grow this industry.

The port of Brunswick is considerably smaller; nevertheless, it is a very important port particularly in relation to the automobile industry. The primary import activity is related to foreign automobiles. Jaguar, Land Rover, Porsche, Mitsubishi, and Volvo are all imported through this port. Ford, GM, and Mercedes use Brunswick as a major exportation hub, moving goods throughout the world.

Military

Since Europeans first arrived in the region there has been a military presence on the Georgia Coast. This tradition continues to this day. The largest military base east of the Mississippi River, Fort Stewart, has, according to the last census, about 11,000 people on base. The Fort Stewart is located in Liberty and Bryan counties and is home to the United States Armies Third Infantry Division. Hunter Army Airfield, an air support installation six miles from Fort Stewart is also a vital part of the region. Taken together these bases account for a major portion of the economy of Liberty County.

The King's Bay Submarine base, near St. Mary's, is also an important military feature along the coast. This base is the largest covered dry dock in the western hemisphere.

Tourism

Tourism has become a major economic feature of the Georgia Coast. Savannah and St Simon's in particular have seen steady growth in this industry. According to a 2002 TIA (Tourism Industry Association) study, tourism on the Georgia Coast accounts for an estimated 1 billion dollars annually. This accounts for an estimated five million trips per year. Coastal tourism is mostly related to people coming to visit the historic locations and various attractions (Economic Impact of Travel on Georgia, 2002).

Historical Sites

Brunswick Old Town Historic District Background: Brunswick was founded in 1771 and contains an outstanding collection of late 19th century residential and public buildings which are the Hazelhurst-Taylor House (Hanover Square), the Mahoney-McGarvey House (Reynolds Street) and the Old City Hall.

Fort Frederica in St. Simon’s Island: The archeological remnants of Frederica are protected by the National Park Service.

Fort King George Structure: Established in Darien, GA in 1721 to stop French and Spanish expansion, the fort was the southernmost outpost of the British Empire in North America. The surviving portions of the first sawmill are significant and rare examples of early colonial industry in Georgia.

First African Baptist Church in Bryan County: In 1793 Bryan obtained the lot where the First Bryan Baptist Church (constructed in 1873) now stands. It is the very first black Baptist church to be established in America. The First African Baptist Church of Savannah, GA evolved from it in 1859.

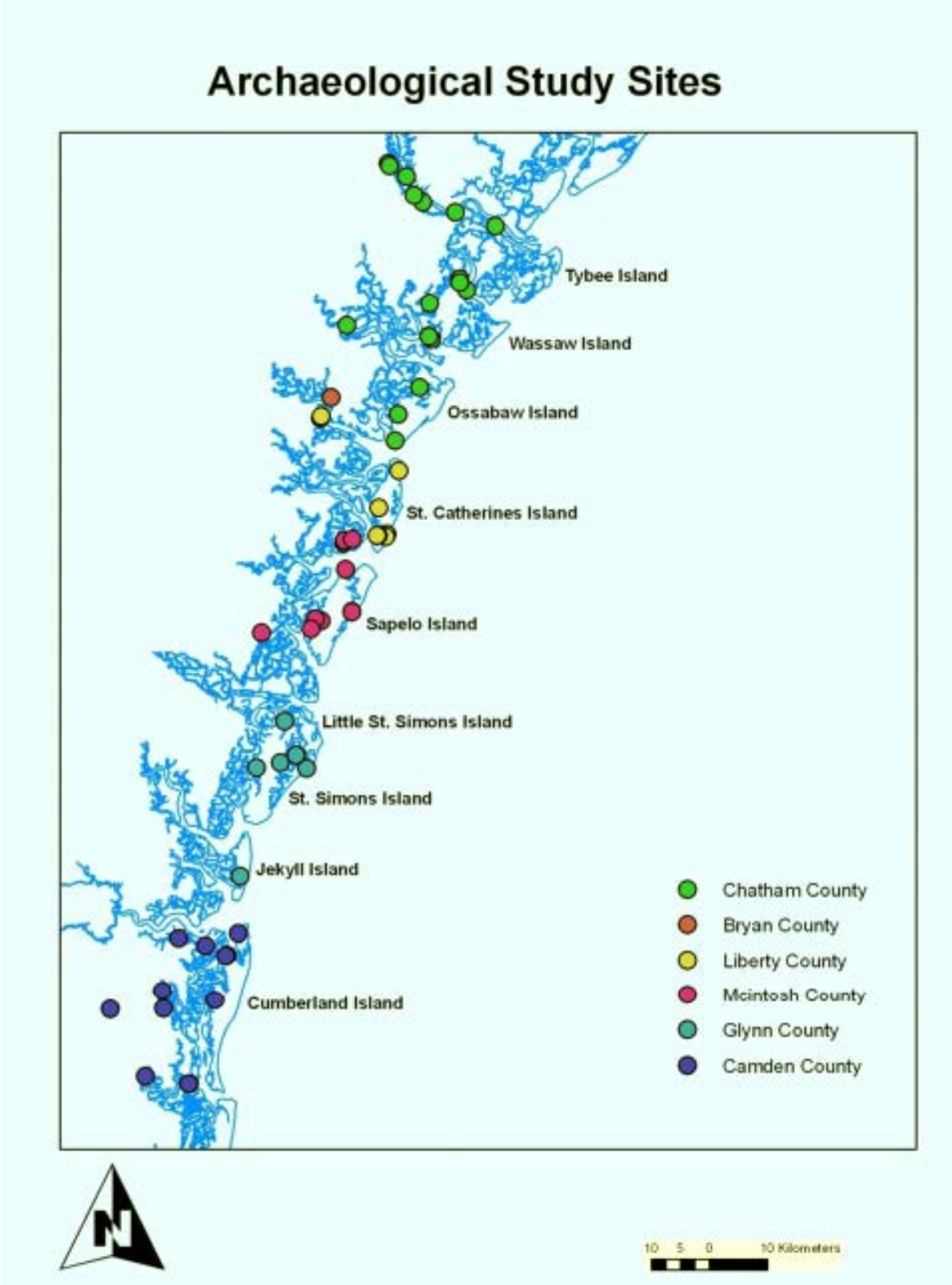
Laurel Grove-South Cemetery in Savannah Georgia: This cemetery is significant as a visual record of African American history in Savannah. In 1852, fifteen acres of the Laurel Grove Cemetery were set aside for the burial of "free persons of color and slaves".

Savannah Historic District: This National Historic Landmark is significant for its distinctive grid plan as well as its 18th and 19th century architecture. Important sites associated with the African American community in the district include Beach Institute (East Harris St) constructed in 1865 as the city's first black school, and the King-Tisdell Cottage (East Harris St) the 1896 home of a working-class African American family.

St. Mary's Historic District: Founded in 1634 and serving as the provincial capital of Maryland until 1695, is probably the only remaining major 17th century town site in the United States that has never been overbuilt. St. John's House, a significant contributing element within the District, is one of the best preserved 17th century archaeological sites in the country. Historic sites in the district include the "Washington Oak" and the 1808 Presbyterian Church, famous for its historic bell, which was cast by Paul Revere (*Discover Georgia's National Park Service Coast & Island Historic Sites*).

Archaeological Sites

Because of the long history of human settlement, the Georgia coast has numerous archeological sites. Map 1.3.1, from *Estuarine Shoreline Mapping Along the Georgia Coast* by C. Alexander, shows the various sites along the coast. As the sea level increases, there is an increased likelihood that these sites will be negatively affected. Damage to buried archaeological resources begins with a rise in the water table, leading to leaching of chemical and organic contents of the site. This results in loss of the information potential of the site to archeologists and historians. Inundation can cause structural damage or loss of historic buildings, historic vistas, and artifacts. For more information please consult the 2008 report *Threatened Archeological, Historic, and Cultural Resources of the Georgia Coast*.



Map 1.3.1. Major Archeological sites in Coastal Georgia Region. Information provided by C. Alexander *Estuarine Shoreline Mapping Along the Georgia Coast*.

Gullah Culture

The Gullah-Geechee are the speakers of the only African American Creole language that developed in the United States. This language combines elements of English and over 30 African dialects. Gullah culture emerged as a result of the complicated patterns of forced immigration and displacement that began as slaves from Africa were brought to Southeast Georgia. The place name, Geechee, derived from the Ogeechee River near Savannah, was used to designate the language and slaves of Coastal Georgia. Oral traditions, folklore, and storytelling are cultural traditions that have gone largely unchanged for generations.

The barrier islands were accessible only by boat until the first bridges were built starting in the early 1950s. Since that time, many traditional Gullah-Geechee communities on the islands have been altered by cultural infiltration from main-landers, or been lost entirely to real estate development. The advent of air-conditioning transformed the hot, humid islands into desirable ocean-side property, bringing outsiders into what was once solely Gullah or Geechee territory. Despite recent losses, the Gullah-Geechee people remain a testament to the power of human adaptability and cultural survival even in the face of outside pressures from the modern world (National Park Service).

Social Vulnerability

To quickly and easily identify which areas in the region have the population who is at the greatest risk, the census block groups within the region were ranked according to the degree of vulnerability. Vulnerability was calculated based on a variation of the methodology provided by Cutter, Boruff, and Shirley in their 2003 paper *Social Vulnerability to Environmental Hazards*.

Scoring of vulnerability was done based on those populations which would require the greatest amount of support in the case of an emergency. Scoring was based on the population density, poverty rates, population over 85 years old, education (specifically those who are counted as having no formal education), and households with young children. This data was collected from the 2010 United States Census American Community Survey 5 year 2013 data set. The composition score demonstrates which areas in the region are at a high risk due to the before mentioned variables. These areas will have populations that in the case of an extreme weather event would require additional support.

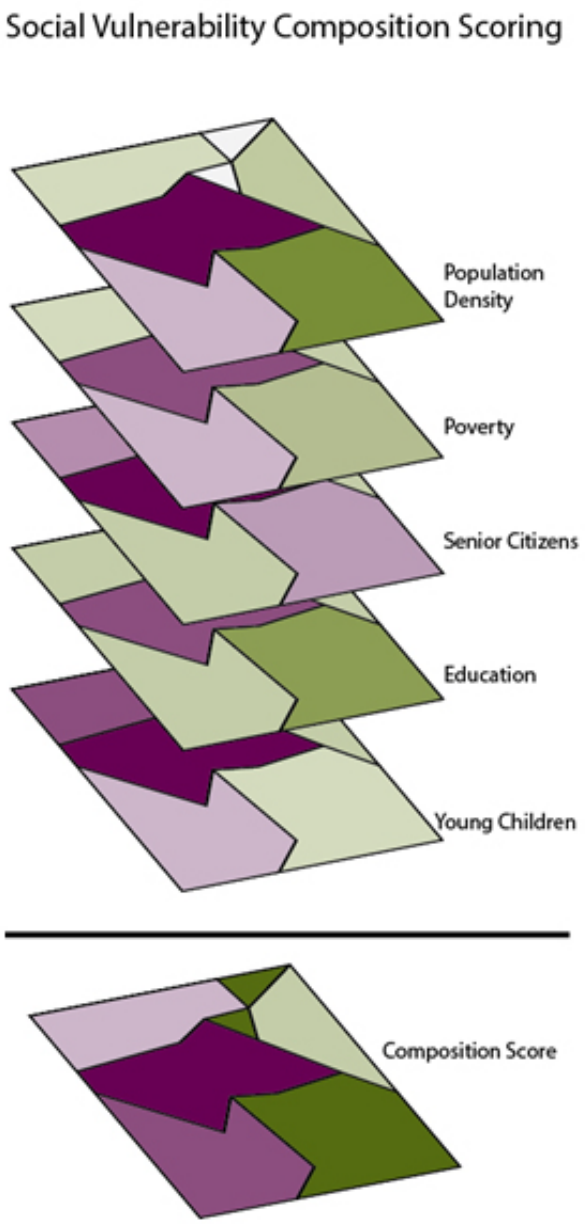


Figure 1.3.7. **Displays the different layers that go into a Social Vulnerability score.**

Business Vulnerability

Using Nielsen business facts point data in composition with storm surge data provides a picture of what sort of damage can be expected from the various types of storms that might hit the coast. This data provided the geo position for every business as well as an estimated number of employees and sales. This data is then combined with storm surge data to best understand and plan for the immediate impact of the various types of catastrophic events.

Storm Type	Businesses Effected	% Total Regional Businesses	Jobs Effected	% Total Regional Jobs	Sales Effected ($000)	% of Regional Sales Effected
Tropical Storm	665	2%	5,388	2%	1,542,195,000	3%
Category 1	2,323	8%	23,270	8%	3,796,970,000	7%
Category 2	8,435	29%	84,079	28%	17,498,820,000	32%
Category 3	16,135	56%	158,000	53%	33,881,203,000	61%
Category 4	21,453	75%	205,758	69%	46,208,863,000	83%
Category 5	22,667	79%	229,344	77%	48,539,801,000	88%

Table 1.3.4. Economic Damage by Hurricane Surge for Coastal Georgia. Information provided by Claritas Nielsen (2013). *Business Facts 2013*. Part 1 [Data file]. NOAA and FEMA.

Based on the data, it becomes apparent that any storm above a Category 1 would affect over a quarter of all businesses. This would have a sizeable effect on the regional economy. Any storm above a Category 2 would cause a massive disruption in the economy that will takes years to recover from. This is not to down-play the effect of any smaller storm system. Even a two percent disruption can cause a ripple effect in the local economy. Sales tax taken in by the county government will also be drastically effected if a storm system was to hit the coast. Local governments should plan for revenue disruption for years after a major catastrophic event.

FEMA Flood Insurance Reform

Possibly the single biggest issue facing the coast right now is the adjustment of the flood insurance rates. Under the new Flood Insurance Reform Act of 2012 many homes and businesses are expected to see massive rate increases over the next few years. As this reform act will bring insurance rates for those buildings below flood elevation (in other words in the flood plain) to the non-adjusted market level there are numerous impacts which can be expected in terms both social and economic.

As the local property owners are the ones who will pay the increased cost of insurance, they will bear the brunt of this new law. People with vacation homes whose insurance has been readjusted might find it difficult to keep up with the increased cost of keeping the property. While it will not affect the insurance rates of current homeowners whose primary residence sits in an at risk area, it may make it impossible for them to sell the house because of the insurance increase. Homes and neighborhoods may become abandoned or derelict.

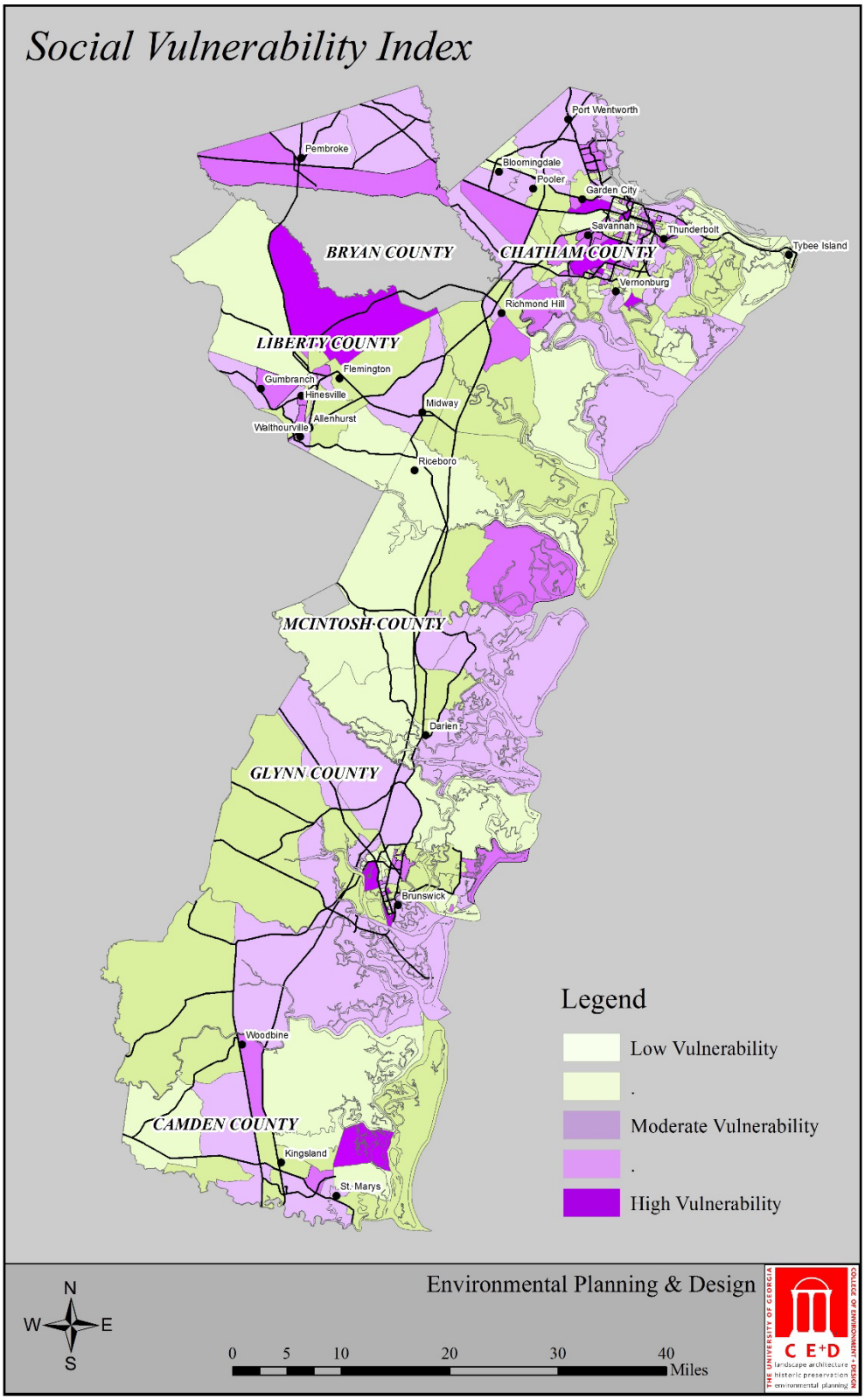
Property owners with vacation homes whose insurance has been readjusted might find it difficult to keep up with the increased cost of keeping the property. These new insurance rates also decrease the likelihood of someone investing in a new vacation home. As only those in the

absolute upper income brackets will be able to afford property in this area, gentrification becomes increasingly probable.

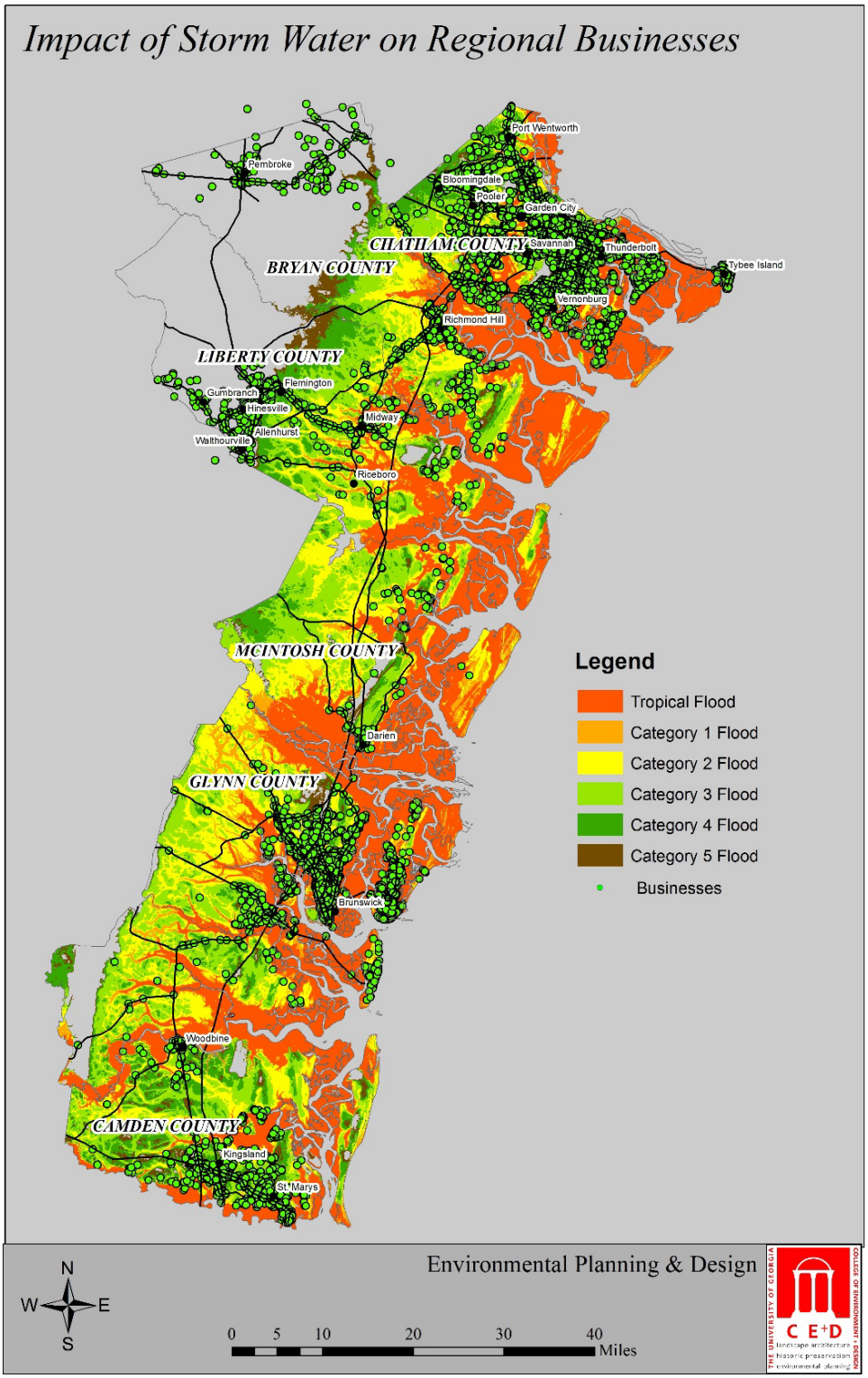
Businesses will be feeling the insurance pinch as well. This may be reflected in higher costs for all as businesses pass on their increased costs to their consumers. Businesses may also be inclined to move their location. This will undoubtedly affect business property holders who will be unable to rent these now expensive properties.

Overall, the new insurance regime will fundamentally change the social and economic composition of the communities along the coast. Residents can do certain things to reduce the readjusted insurance rates. Raising the level of buildings, relocating buildings, raising utilities above the ground, removing water entrances into basements, permeable flooring in the basement, and many other structural changes are solutions suggested by FEMA. As the new rates come into effect over the next few years, the full impact will become clear (Federal Emergency Management Agency, 2007).

Using Neilsen business facts point data in comparison with storm surge data provides a picture of what sort of damage can be expected from various types of storms that might hit the coast. The data provided the geo position for every business as well as an estimated number of employees and sales. It was then combined with storm surge data from NOAA and FEMA to best understand and plan for immediate impact of various types of catastrophic events.



Map 1.3.2. Coastal Georgia composition index composed of Total Number of Households, Total Population, Poverty Per Capita, Elderly People Per Capita, Lack of Education Per Capita, and Small Children Per Capita weighted equally. Information provided by US Census, and American Community Survey.



Map 1.3.3. Impact of Storm Water on Regional Businesses. Data provided by Claritas Nielsen, NOAA, FEMA.

1.4 Infrastructure

Introduction

The threat of inundation from storm surge and sea level rise has resulted in the need for Coastal Georgia to develop and refine hazard mitigation strategies. An approximant population of 500,000 has made it crucial for Coastal Georgia to develop a resilient infrastructure network to support the regions daily activities and emergency services. Thus, providing a regional hazard mitigation plan that emphasizes resilience in coastal counties is essential for a safe sustainable future. The guidelines presented in Task 5 of the FEMA Hazard Mitigation Handbook were followed to assess the infrastructure of the following six Coastal Counties: Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden County. According to FEMA guidelines, the most critical infrastructure systems and facilities to evaluate for mitigation opportunities include transportation, communication, power water and wastewater, and emergency services.

The following chart from FEMA Hazard Mitigation Handbook summarizes these critical areas:

Example

Infrastructure and Critical Facilities

Critical Facilities	High Potential Loss Facilities	Infrastructure Systems
Hospitals and medical facilities	Nuclear power plants	Water and wastewater
Police and fire stations	Dams	Power utilities
Emergency operations centers	Military and civil defense installations	Transportation (roads, railways, waterways)
Evacuation shelters	Locations housing hazardous materials	Communication systems/centers
Schools		Energy pipelines and storage
Airports/heliports		

Table 1.4.1. FEMA Hazard Mitigation Handbook, page 57.

Unfortunately, county data for some types of infrastructure was unavailable, so the main focus of assessment is transportation, emergency evacuations routes, and communication networks. Throughout the assessment process, an evaluation on the dependencies between infrastructure systems, critical facilities, and the population they serve was conducted. Proposals for effective mitigation strategies are general and mean to serve as guidelines, which can be tailored for more specific applications which conform to the county's need.

Methods

1.) Data was collected in the conducting of this assessment from the following different sources: FEMA, GEMA, NOAA, Georgia Department of Transportation, Dewberry consulting, Coastal Regional Commission, and the six coastal counties.
2.) Several informational maps were created in ArcGIS by the overlaying of different types of infrastructure with storm surge and population data.
    a. This method allowed for the quick identification of areas of higher risk in the event of a tropical storm or hurricane.
3.) An assessment of the vulnerability of infrastructure systems for each county by hurricane category was conducted.
    a. In order to create an assessment, FEMA guidelines and CRC documents were examined; criteria were formed based on this structure.
    b. Infrastructure was divided into three main categories: transportation, communication, and critical facilities. The categories were further divided into subcategories.
        i. A number of infrastructure items affected by hurricane category were calculated.
4.) For single item infrastructure, such as cell towers and bridges, a count of each item was conducted. For infrastructure such as roads and railroads, mileage per hurricane category was conducted. These calculations, along with the GIS analysis, allowed for the identification of areas within each county whose infrastructure is more vulnerable to storm surge and flooding.
5.) From this information 3 Scenarios were created.

Assessment

After quantifying data in GIS, a chart was then created to illustrate how these numbers demonstrates a pattern reflective of the overall vulnerability of each county in terms of their infrastructure systems. This chart is divided into three scenarios, each representing the different hurricane category. Scenario 1 represents a tropical storm, which is in its own category, since this storm is most likely to occur and cause excessive flooding. Scenario 2 represents hurricane categories 1 and 2, which reflects a remarkable increase in potential inundation. Finally, Scenario 3 represents hurricane categories 3, 4, and 5. In order to visually display the change in impact from one scenario to another, a rating of high, medium, or low to each feature. These ratings were based on a total percentage of 100%, divided into three equal parts. A “low” rating shows that less than 33% of an infrastructure type would be affected, “medium” shows that less than 67% would be affected, and the “high” rating means that over

67% of the infrastructure would be potentially inundated. If the range between hurricane categories resulted in two different ratings, the higher rating was applied.

The initial vulnerability assessment of infrastructure for each county identifies a number of infrastructure types per county that will be affected by tropical storms up to category five hurricane. Critical areas were based on categories from Task 5 in the FEMA document. The counties with the highest number reflect highly vulnerable areas that should be noted as "Critical Areas". Major roads, bridges communication tower and water facilities are most important in terms of resilience as they serve the core daily needs of the population. Based on the assessment charts below, Chatham, Glynn, and Camden counties have the highest number of infrastructure features, and have the largest amount of critical infrastructure that would be affected by a storm. Each of these counties also contain inhabited barrier islands which play a crucial role in protecting the mainland, but are becoming more susceptible to damage as urban development increases. Such areas are especially susceptible during large storms. Flash flooding may inundate important transportation routes, or even block emergency evacuations. For example, each of these barrier islands, Tybee, Saint Simons, and Jekyll are at sea level or a few feet above and has a single road leading off the island. During evacuation, road inundation will cause major problems. Adequate planning is needed to insure that transportation routes can be integrated with existing routes. From this initial assessment a second chart was created to reflect overall the vulnerability of each county's infrastructure, and determine any patterns.

An initial table was created to show the vulnerability assessment of critical infrastructure systems in each county. Some counties did not have public data available for certain types of infrastructure, which is noted with "N/A". The totals reflect the levels of vulnerability of counties and their infrastructure networks to the effects of storm surge. McIntosh County has no emergency evacuation route data, which means that their hazard mitigation plans need to be updated or they need to develop appropriate evacuation routes that can be integrated with existing routes.

Tables 1.4.2 to 1.4.4 reemphasizes the vulnerability of each of the counties by the three different scenarios, outlined in the "methods" section of this report for Chatham, Glynn, and Camden County mitigating infrastructure networks in these areas should be a priority in a regional mitigation plan. Data was gathered from NOAA, the Georgia Department of Transportation, FEMA, GEMA, and each individual county website. Based on both sets of data, it was determined that transportation was a top concern in all six Counties, being one of the more heavily used and exposed types of infrastructure; furthermore, the ports in Savannah and Brunswick added importance to transportation. Transportation routes, such as I-17, connect one hub to another, and critical areas along such major arterials must be highlighted. The threat of flooding throughout the region is of concern, especially along I-17, where many bridges and parts of the roads are near sea level elevation. Another major concern here, are the condition and location of evacuation routes. The infrastructure connected to these routes should be reevaluated by each county to ensure that the quality meets performance standards. Furthermore, the age and condition of major arterials and bridges, as well as the traffic count and population in such areas are especially important when developing mitigation strategies and prioritizing infrastructure based on quality and use.

Transportation infrastructure is especially important in the port cities of Savannah and Brunswick. As one of the busiest ports in North America, the port of Savannah requires an intricate network of infrastructure to support and maintain its services; thus, these two cities will always have a higher vulnerability rating. The failure of port services, due to the failure of transportation routes, will have detrimental effects on the economy.

The results of Scenario 1 (Tropical Storm) are shown in Table 1.4.2. Though the vulnerability rating seems low, it is important to remember that flooding still occurs and a "low" rating does not mean there will be no damage, only that the storm surge levels and threat for inundation is lower. However, the most critical infrastructure for a certain county may be inundated, even with this low rating. It is up to the county or cities within to assess which of their structures, especially along the coastline, should receive priority in mitigation strategies. The location, usage, and condition of the structure needs to be considered when assessing their priority. The Recommendation section of this report describes the process of creating a "priority" list in more detail. Since this scenario involves mostly flood damage possibilities, high attention should be paid to storm water management mitigation, to keep roads, houses and business from being flooded. Flood gates, such as those in Tybee Island, are a possible solution to managing flood water in a coastal community. Effectively managing flood water subsequently protects most other forms of critical infrastructure.

Scenario 2 (table 1.4.3) shows an increased risk in the affected area from a tropical storm in Scenario 1. These are hurricane categories that do not seem as threatening as larger storms, but in fact would incur quite a lot of potential damage due to storm surge and aggressive flooding. Glynn and McIntosh counties have high vulnerability ratings, since the majority of their critical infrastructure may be affected. Chatham and Camden County have medium ratings, but could be considered high-risk since most of the population lives near a river or the ocean. Each of these counties also have inhabited barrier islands which should be marked as highly vulnerable areas due to their limited access to the mainland. Though Liberty and Bryan County still show a "low" rating, they are vulnerable, as they serve as connection hubs between the northern and southern parts of the region, especially connecting the highest populated port cities of Savannah and Brunswick.

Scenario 3 (Table 1.4.4) reflects the highest threat to the coastal region. In this scenario, the majority of counties are at high risk. Even in a category 3 hurricane, the majority of the coastal population and urban development areas will be affected. Though this scenario seems least likely than the others, it should be planned for and considered when updating existing infrastructure systems or building new ones. Planning for the highest level threat is an efficient mitigation strategy that increases overall resilience of this region.

Scenario 1: Tropical Storm											
County	Critical Infrastructure										Overall Vulnerability Rating
	Communincation		Transportation				Ports*	Water Facilities*	Waste Facilities*	Power Stations*	
	Cell Towers*	Antenna Towers*	Roads**	Railroads**	Bridges*	Evacuation Routes**					
Chatham	2/12	8/127	139.4 /1778.1	16.43/179.5	60/265	1.11/79.9	1/1	1/8	N/A	N/A	9
Bryan	0/8	0/31	21 /528.4	1.33/38.7	8/88	0.15/64.6	N/A	N/A	N/A	N/A	6
Liberty	0/5	0/40	69.8 /1238.6	1.64/42.3	25/75	0.24/56.5	N/A	N/A	N/A	N/A	7
McIntosh	0/5	0/18	149.3 /961.5	0/18.5	26/71	N/A	N/A	N/A	N/A	N/A	10
Glynn	0/8	15/63	130.8 /855.4	3.06/88.4	30/90	0.25/50	1/1	N/A	N/A	N/A	10
Camden	1/10	2/39	106.1 /763.6	5.8/54.7	44/133	0.31/24.47	N/A	N/A	N/A	N/A	7
Total	**48**	**318**	**6125.5 mi**	**421.8 mi**	**724**	275. 5	2	N/A	N/A	N/A	
LEGEND	Low	Medium	High		*** Calculated by count** **** Calculated in miles**			*Sources: NOAA, GDOT, FEMA, GEMA, Individual County Data & Documents*			

Table 1.4.2. Scenario 1: Tropical Storm. Data provided by NOAA, GDOT, FEMA, GEMA and Individual county data & documents.

Scenario 2: Category 1 & 2 Hurricane											
County	Critical Infrastructure										Overall Vulnerability Rating
	Communincation		Transportation				Ports*	Water Facilities*	Waste Facilities*	Power Station*	
	Cell Towers*	Antenna Towers*	Roads**	Railroads**	Bridges*	Evacuation Routes**					
Chatham	7-9/12	14-38/127	295.5-695.15 /1778.1	24.85-71.28/179.5	69-114/265	2.71-14.07/79.9	1/1	N/A	N/A	N/A	13
Bryan	0-1/8	1-12/31	50.8-171.9 /528.4	1.63-7.55/38.7	12-17/88	0.98-7.80/64.6	N/A	N/A	N/A	N/A	7
Liberty	0/5	1-9/40	105.8-273.6 /1238.6	2.67-10.38/42.1	29-45/75	1.11-6.53/56.5	N/A	N/A	N/A	N/A	7
McIntosh	0/5	3/18	224.8-539.3 /961.5	0.78-6.58/18.5	49/71	N/A	N/A	N/A	N/A	N/A	13
Glynn	4/8	46/63	280.3-611.5 /855.4	13.86-55.47/88.4	54/90	2.38-17.93/50	1/1	N/A	N/A	N/A	17
Camden	3/10	10/39	165.7-371.9 /763.6	5.85-18.95/54.7	85/133	0.80-2.63/24.47	N/A	N/A	N/A	N/A	10
Total	**48**	**318**	**6125.5 mi**	**421.8 mi**	**724**	275. 5	2	N/A	N/A	N/A	
LEGEND	Low	Medium	High		* Calculated by count ** Calculated in miles			*Sources: NOAA, GDOT, FEMA, GEMA, Individual County Data & Documents*			

Table 1.4.3**. Scenario 2: Category 1 and 2 Hurricanes. Data provided by NOAA, GDOT, FEMA, GEMA and Individual county data & documents.**

Scenario 3: Category 3, 4, & 5 Hurricane											
County	Critical Infrastructure										Overall Vulnerability Rating
	Communincation		Transportation				Ports*	Water Facilities*	Waste Facilities*	Power Stations*	
	Cell Towers*	Antenna Towers*	Roads**	Railroads**	Bridges*	Evacuation Routes**					
Chatham	11-12/12	90-119/127	1236.5-1634.2 /1778.1	132.35 170.48/179.4	172-250/265	37.45 72.19/79.9	1/1	N/A	N/A	N/A	21
Bryan	3/8	16/31	227.8-240.4 /528.4	14.08-18.04/38.7	36-52/88	20.44-26.93/64.58	N/A	N/A	N/A	N/A	12
Liberty	4/5	19-24/40	520-636.2 /1238.6	22.04-28.50/42.1	54-58/75	13.25-23.96/56.5	N/A	N/A	N/A	N/A	14
McIntosh	3/5	11-14/18	810.4-915.95 /961.5	17.3-18.5/18.5	65-69/71	N/A	N/A	N/A	N/A	N/A	17
Glynn	8/8	60-63/63	751.9-822 /855.4	82.1-87.28/88.4	72-76/90	40.58-47.68/50	1/1	N/A	N/A	N/A	18
Camden	3-10/10	20-37/39	545.7-716.4 /763.6	38.73-51.49/54.7	103-129/133	9.34-22.1/24.5	N/A	N/A	N/A	N/A	18
Total	**48**	**318**	**6125.5 mi**	**421.8 mi**	**724**	275. 5	2	N/A	N/A	N/A	
LEGEND	Low	Medium	High		* Calculated by count ** Calculated in miles			*Sources: NOAA, GDOT, FEMA, GEMA, Individual County Data & Documents*			

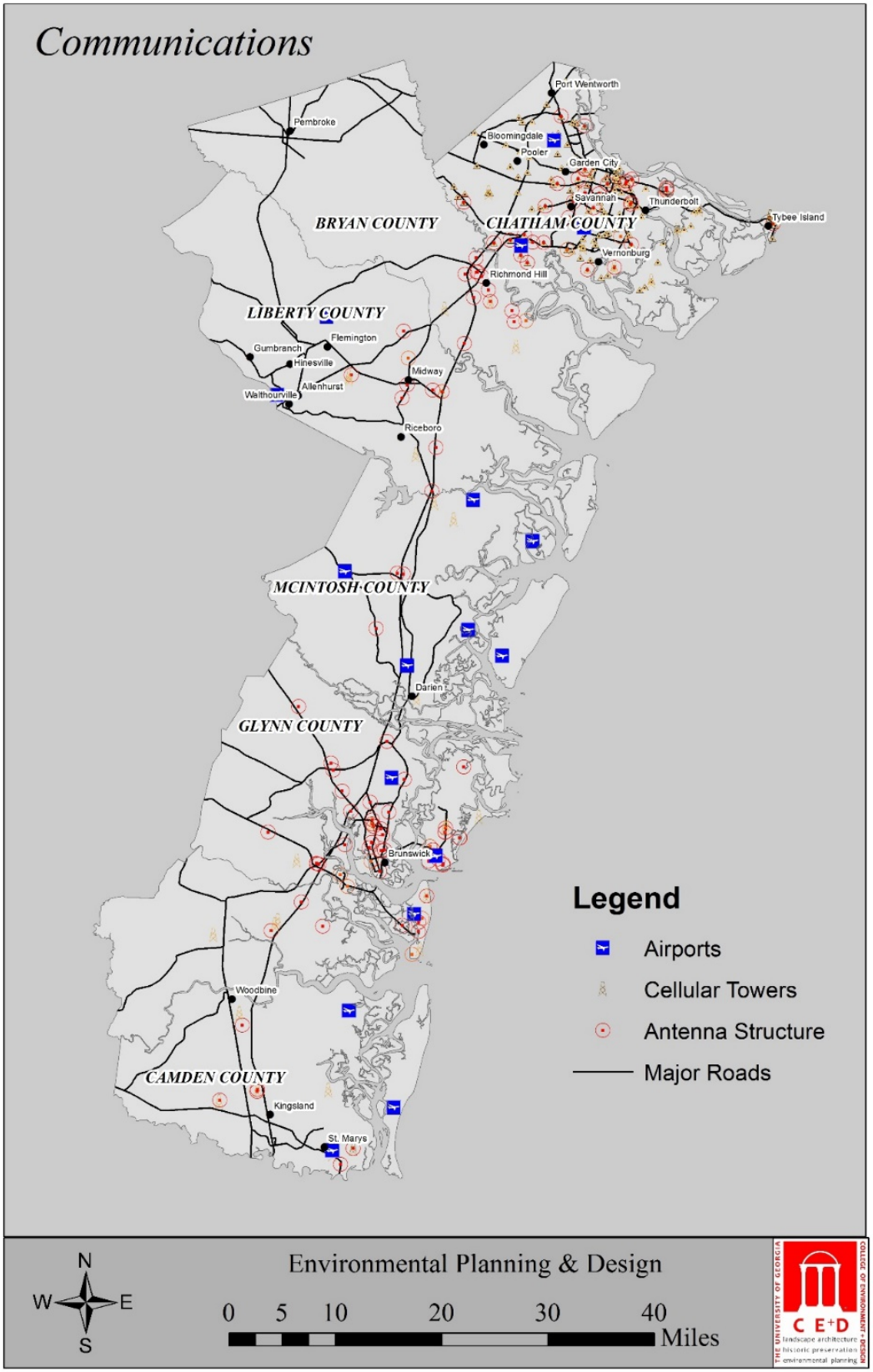
Table 1.4.4. Scenario 3: Category 3, 4, and 5 Hurricanes. Data provided by NOAA, GDOT, FEMA, GEMA and Individual county data & documents.

Maps

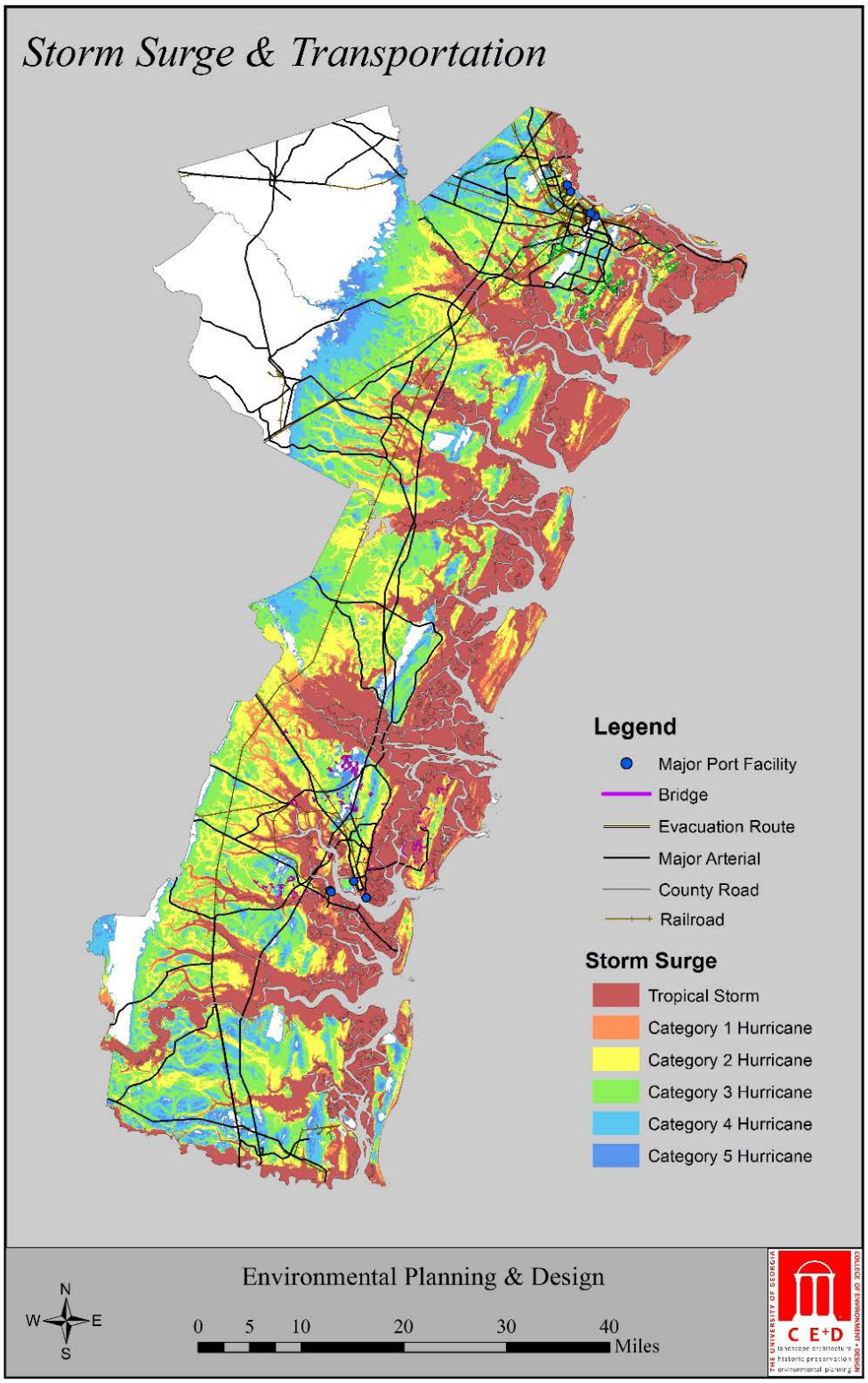
Map 1.4.1 provides a visual of which of the six coastal Georgia counties are most vulnerable to storm surge during a tropical storm up to a category five hurricane. Areas that have the highest number of critical transportation infrastructure, such as major arterials, evacuation routes, railroads, bridges, and port facilities, appear to be the most congested with infrastructure symbols. Because of their proximity to the coast, each of these areas would be effected even in a tropical storm.

Map 1.4.2 displays different types of communication networks, including cellular towers, antenna structures, telecommunication towers, and airport communication systems to give a visual of areas with the highest concentration of this type of infrastructure. These areas, have the highest coastal populations, and thus would be most affected by damage from a tropical storm or hurricane.

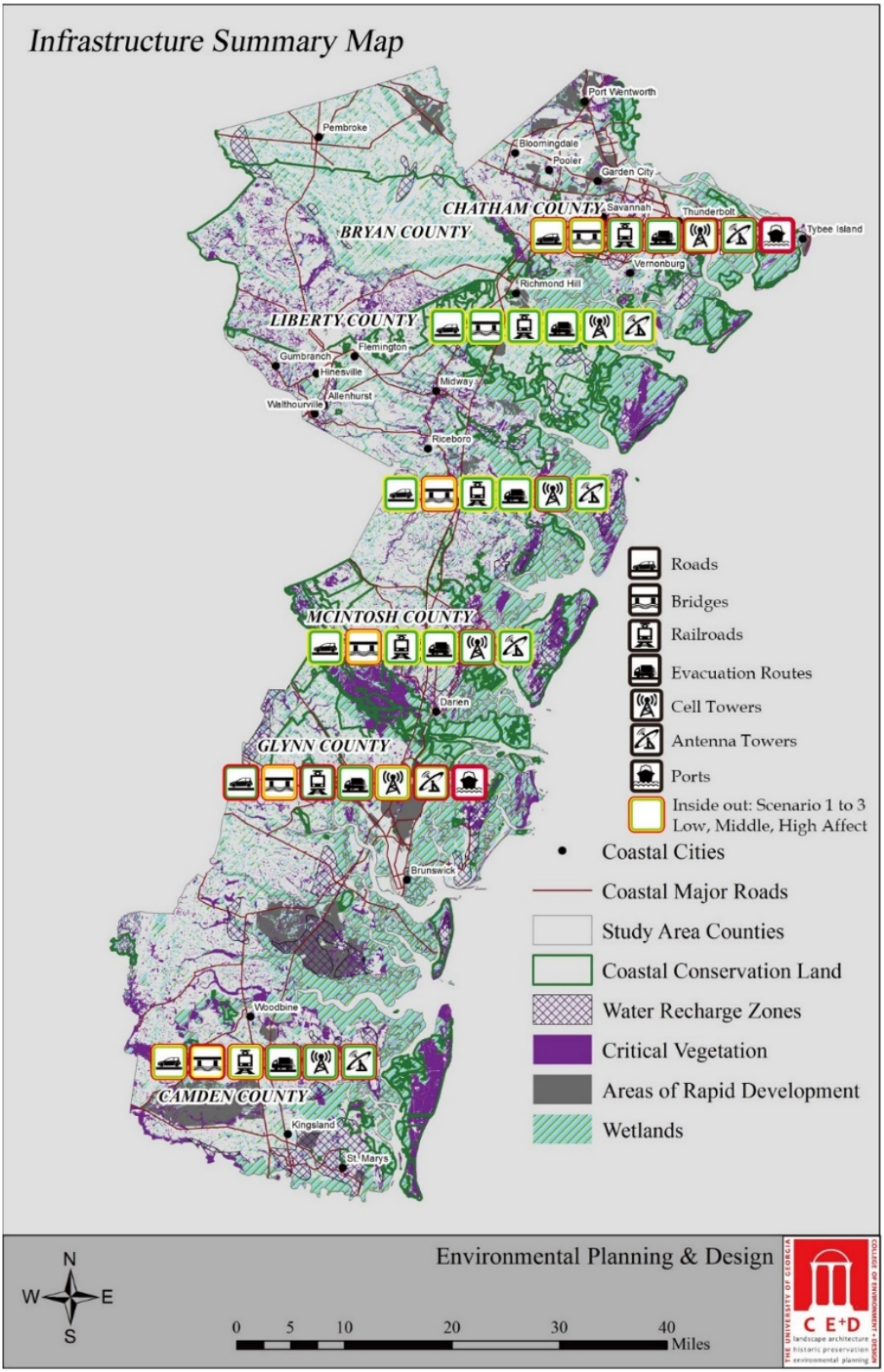
Based on initial assessment, Chatham County, Glynn County, Camden, and McIntosh Counties have the highest number of "critical areas", making them the most vulnerable counties in the event of storm surge or flooding. Each of these counties contain rapidly growing areas near larger cities located close to the coast. As these cities continue to expand, it is crucial to implement effective mitigation strategies in order to protect existing infrastructure and guide future development to less vulnerable areas. In the event of a hurricane or other disaster event, infrastructure systems are highly depended upon for moving large populations to safer areas and supporting these populations as they rebuild their communities. The following map displays different types of scenarios and infrastructure that are affected.



Map 1.4.1. Storm Surge and Communication. Various sources.



Map 1.4.2. Storm Surge and Transportation



Map 1.4.3. Summary of Infrastructure

1.5 Built Environment

Introduction

Community agenda represents one of the main outcomes for comprehensive plans. This describes how planners determine the community goals and aspirations in terms of community development. The history of Georgia's urban planning/urban redevelopment act goes back to 1955 when federal funds were focused on improving living conditions and addressing the poverty in blighted American cities. Although federal funding is still focused on the improvement of the city condition, the amount of federal funding available has significantly decreased. Coastal cities specifically are not only facing the problems of poverty but also of natural hazards. To effectively utilize federal funding during disaster mitigation and to avoid conflicts the region needs to adopt a unified set of rules that each county and individual city can employ. Comprehensive plans and community agendas describe the government's ability to protect the health and welfare of the citizens. Generally, the state government requires the local government to plan comprehensively in order to obtain state funding. This is the case in Georgia, which can make it difficult to work cohesively at a city and county level. There are many gaps within each comprehensive plan. The goal was to identify those gaps and create consistent documents for each county so they can be beneficiated equally by federal funding.

Another important factor that needs to be included in a comprehensive plan for coastal cities is their building construction codes. It is important to consider construction standards specified by the FEMA guidelines because it can reduce health hazards during flood events. It can also assist in reducing damages to building infrastructure and supply lines (gas, water, electricity, etc.). Flood insurance rates, as specified by the National Flood Insurance Program (NFIP), will also reduce damages by complying with FEMA standards. A successful building design is only considered successful if it is capable of resisting damage from coastal hazards over a particular period of time. It does not mean that the building is immune to damage, it means the impact of flood, storm, wind or erosion will be limited to the foundation, envelop, base floor board, structural elements, and utilities.

Methodology

1) Assessment of existing conditions of the region.
   - Focus on areas of rapid development and indicators of population (airports, schools, and hospitals).
2) Literature review
3) Review/Inventory of current hazard mitigation plans, comprehensive plans, and community agendas at a city and county scale.
4) Identify gaps within each plan

- What year was the document created?
- Number of pages in document? (Provides a sense of the thoroughness of each document)
- Make an inventory of “key words” throughout document.

5) Create a ranking system based upon above criteria for each county and city.
6) Display all information on an easy to read chart.
7) Map information to represent data spatially.

Assessment

Based on different criteria’s, two different assessment were done for the existing plans in the counties.

1) Comprehensive plans, community agendas, and hazard mitigation plans:
Key words were identified for each Comprehensive Plan, Community Agenda and Hazard Mitigation plan, which are: a. Beach, b. Dune, c. Shore, d.Buffer, e. Riparian, f. "Estuar", g. Marsh, h. Swamp, i. Wetland, j. Erosion, k. "Sediment", l. Soil, m. Flood, n. Storm, o. Aquifer, p. Reservoir, q. Brownfield, r. Grey/Grayfield, s. Infil, t. Disaster, u. Hazard, v. Risk, w. Prevention, x. Prevention (in relation to crime), y. Protection, z. "Mitig", z1. "Re-mediat".

All key words listed in quotes are due to variations of the word being present within certain documents. For example, “mitig” would identify every time the words mitigate, mitigates, and mitigation are mentioned. Similar words are grouped together on the, “Review of Community Agendas & Hazard Mitigation Plans,” chart. The keyword groupings are as follows:

1. Beach/Dune/Shore
2. Buffer
3. Riparian/Estuaries
4. Marsh/Swamp/Wetland
5. Erosion/Sediment/Soil
6. Flood/Storm
7. Aquifer/Reservoir
8. Brownfield/Greyfield or Greyfield/Infill
9. Disaster/Hazard/Risk
10. Prevention
11. Protection
12. Mitigation/Remediation
13. Overall Ranking

With the above findings, two different assessments were done

A) Based on color coding:

Color rankings show the review of document based on how well the identified issue has been addressed in the different documents adopted by county for community improvement. The review was based on scanning through the documents for the key words and then understanding that how well these key words were addressed. Table 1.5.2 shows the different criteria's each color represents in the Table 1.5.1 a, b and c.

B) Based on numerical ranking:

After the detail assessment and evaluation of different documents were done for the issues identified, a numerical ranking was assigned (ranging from 0-3) to each issue depending on how well the topic was addressed by the counties. Map 1.5.1 shows the diagrammatic representation of this ranking system. Red symbolizes that the issue needs critical attention in the planning document, yellow symbolizes that the issue has been addressed but still need improvement in some parts, and green symbolizes that the issue has been very well addressed. Ranking zero represent missing information or irrelevant issue. On the basis of this ranking provided to each issue, an overall ranking was calculated for each county which is shown in the last column of table 1.5.1c. A similar assessment with the same criteria was done for the hazard mitigation plans for all the counties which is shown in table 1.5.3 a and b.

County	City	Year	Pages in Document	Beach	Dune	Shore	Buffer	Riparian	"Estuar"	Marsh
	Community Agendas/Comprehensive									
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	Last 41 of 140	0	0	0	9	0	0	1
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	First 99 of 140	0	0	0	18	0	0	3
Camden	Camden- Joint Comprehensive Plan	Oct- 2008	150	2	0	2	13	0	0	29
Chatham	Chatham County/Savannah-Tricentennial Plan	Nov- 2006	149	0	0	4	46	8	13	44
Chatham	Garden City- Community Agenda	Oct- 2008	117	0	0	0	17	1	0	2
Chatham	Port Wentworth- Community Agenda	Oct- 2008	137	0	0	0	4	0	0	5
Chatham	Tybee Island Master Plan-Community Agenda	Jan-2008	169	121	25	0	14	2	0	52
Glynn	Glynn County Comprehensive Plan Update	Oct- 2008	59	11	0	0	5	0	0	13
Glynn	Brunswick- Community Agenda	May-2008	98	3	0	3	1	0	0	33
Liberty	Liberty Community Assessment Consolidated	June-2008	331	0	2	0	18	0	0	36
McIntosh	McIntosh & City of Darien Community Assessment Joint	Oct- 2007	190	8	11	16	3	0	20	71

Table 1.5.1a. Evaluation of different documents like Comprehensive Plan and Community Agenda Documents by a color-coding system to understand how and in what depth the individual issues are addressed by individual counties.

County	City	Year	Pages in Document	Swamp	Wetland	Erosion	"Sediment"	Soil	Flood	Storm
	Community Agendas/Comprehensive									
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	Last 41 of 140	1	11	0	0	0	1	7
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	First 99 of 140	0	16	3	2	1	3	6
Camden	Camden- Joint Comprehensive Plan	Oct- 2008	150	1	13	0	0	6	1	10
Chatham	Chatham County/Savannah-Tricentennial Plan	Nov- 2006	149	0	16	4	4	9	18	38
Chatham	Garden City- Community Agenda	Oct- 2008	117	0	6	6	6	2	7	34
Chatham	Port Wentworth- Community Agenda	Oct- 2008	137	4	4	3	3	0	9	30
Chatham	Tybee Island Master Plan-Community Agenda	Jan-2008	169	0	3	4	3	0	5	34
Glynn	Glynn County Comprehensive Plan Update	Oct- 2008	59	0	37	1	0	4	38	26
Glynn	Brunswick- Community Agenda	May-2008	98	0	26	1	0	5	29	40
Liberty	Liberty Community Assessment Consolidated	June-2008	331	0	35	21	16	21	37	17
McIntosh	McIntosh & City of Darien Community Assessment Joint	Oct- 2007	190	18	62	3	4	16	40	21

Table 1.5.1b. Evaluation of different documents like Comprehensive Plan and Community Agenda Documents by a color-coding system to understand that how and in what depth the individual issues are addressed by individual counties

County	City	Year	Aquifer	Reservoir	Brown-field	Grey/Gray-field	Infill	Disaster	Hazard	Risk	Prevention	(in relation to crime)	Protection	"Mitig"	"Remediat"	RANKING
	Community Agendas/Comprehensive															
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	0	0	5	5	8	0	0	0	0	0	36	5	0	1
Bryan	Bryan County and the Cities of Pembroke and Richmond	Oct- 2008	2	0	0	0	8	0	3	1	0	0	99	2	0	1
Camden	Camden- Joint Comprehensive Plan	Oct- 2008	0	0	0	0	37	2	1	0	1	0	129	9	0	1
Chatham	Chatham County/Savannah-Tricentennial Plan	Nov- 2006	4	1	4	4	16	0	4	5	27	2	138	7	0	1
Chatham	Garden City- Community Agenda	Oct- 2008	0	0	3	3	23	1	1	0	4	0	55	4	0	1
Chatham	Port Wentworth- Community Agenda	Oct- 2008	0	0	0	1	29	1	2	0	8	0	50	1	0	1
Chatham	Tybee Island Master Plan-Community Agenda	Jan-2008	3	0	0	0	60	4	1	0	6	0	83	3	0	1
Glynn	Glynn County Comprehensive Plan Update	Oct- 2008	0	0	0	1	19	0	4	0	14	0	29	0	0	1
Glynn	Brunswick- Community Agenda	May-2008	2	0	15	7	0	0	8	8	11	7	57	13	7	1
Liberty	Liberty Community Assessment Consolidated	June-2008	0	0	23	23	69	1	0	9	8	0	251	0	0	2
McIntosh	McIntosh & City of Darien Community Assessment Joint	Oct- 2007	17	0	2	2	18	1	1	0	2	1	142	4	0	2

Table 1.5.1c. Evaluation of different documents like Comprehensive Plan and Community Agenda Documents by a color-coding system to understand that how and in what depth the individual issues are addressed by individual counties

	= Need to address the issue
	= Needs to be addressed further
	= Not necessarily significant
	= Good score
	= A score of zero that is irrelevant because issue is ultimately addressed

Table 1.5.2. Assessment criteria's defining tables 1.5.1a, b, & c

	Year	Number of Pages in Document	Beach	Dune	Shore	Buffer	Riparian	"Estuar"	Marsh	Swamp	Wetland	Erosion	"Sediment"	Soil	Flood
Hazard Mitigation Plan															
Bryan County			0	0	0	0	0	0	0	0	0	0	0	0	0
Camden County	?	185	5	4	3	3	0	1	27	1	10	52	10	3	225
Chatham County	Dec- 2010	240	5	3	3	9	0	0	6	1	7	5	0	2	246
Glynn County			0	0	0	0	0	0	0	0	0	0	0	0	0
Liberty County	2010	120	4	4	4	4	0	0	6	0	10	8	3	4	234
McIntosh County			0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1.5.3a. Evaluation of different documents of hazard mitigation plans, by a color-coding system to understand how and in what depth the individual issues are addressed by individual counties

	Year	Number of Pages in Document	Storm	Aquifer	Reservoir	Brown-field	Grey/Gray-field	Infill	Disaster	Hazard	Risk	Prevention	(in relation to crime)	Protection	"Mitig"	"Remediat"	RANKING
Hazard Mitigation Plan																	
Bryan County			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Camden County	?	185	274	6	0	0	0	0	106	642	74	25	0	95	529	0	1
Chatham County	Dec- 2010	240	236	0	0	0	0	0	513	996	158	19	0	103	997	0	1
Glynn County			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Liberty County	2010	120	175	1	6	0	0	0	44	569	147	20	0	54	608	0	1
McIntosh County			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1.5.3b. Evaluation of different documents of hazard mitigation plans by a color-coding system to understand how and in what depth the individual issues are addressed by individual counties

	= Need to address the issue
	= Needs to be addressed further
	= Not necessarily significant
	= Good score
	= A score of zero that is irrelevant because issue is ultimately addressed

Table 1.5.4. Assessment criteria's defining figure 1.5.3a and 1.5.3b

2) Building construction codes:
   Building construction codes are assessed utilizing the criteria from, "Home Builder's Guide to Coastal Construction" document by FEMA based on:
   A) Do the counties have a well laid out building construction code for the whole county
   B) Does the construction code comply with the FEMA's builder's guide specifically in terms of:
      - Designation of Conservation areas.
      - Consideration of Flood Plain Elevation
      - Identification of Different Flood Zone
      - Relocation\Alteration of Utilities like water lines, gas lines
      - Foundation specifications
      - Lowest floor level
      - Bottom horizontal structure level
      - Construction below base flood elevation
      - Enclosures below BFE (Base flood elevation)
      - Addition and Reconstruction
      - Building forms
      - Building construction standards and materials

A chart utilizing a color coded system with a color coding of red (not in compliance with FEMA's Document), yellow (have discussed but not in detail) and green (comply with FEMA's Building Code) that specifies the depth to which each county has considered the FEMA builder's code. An assessment and overall ranking (from 0-3) was given to each county for their efforts for incorporate FEMA's standards in their building construction codes.

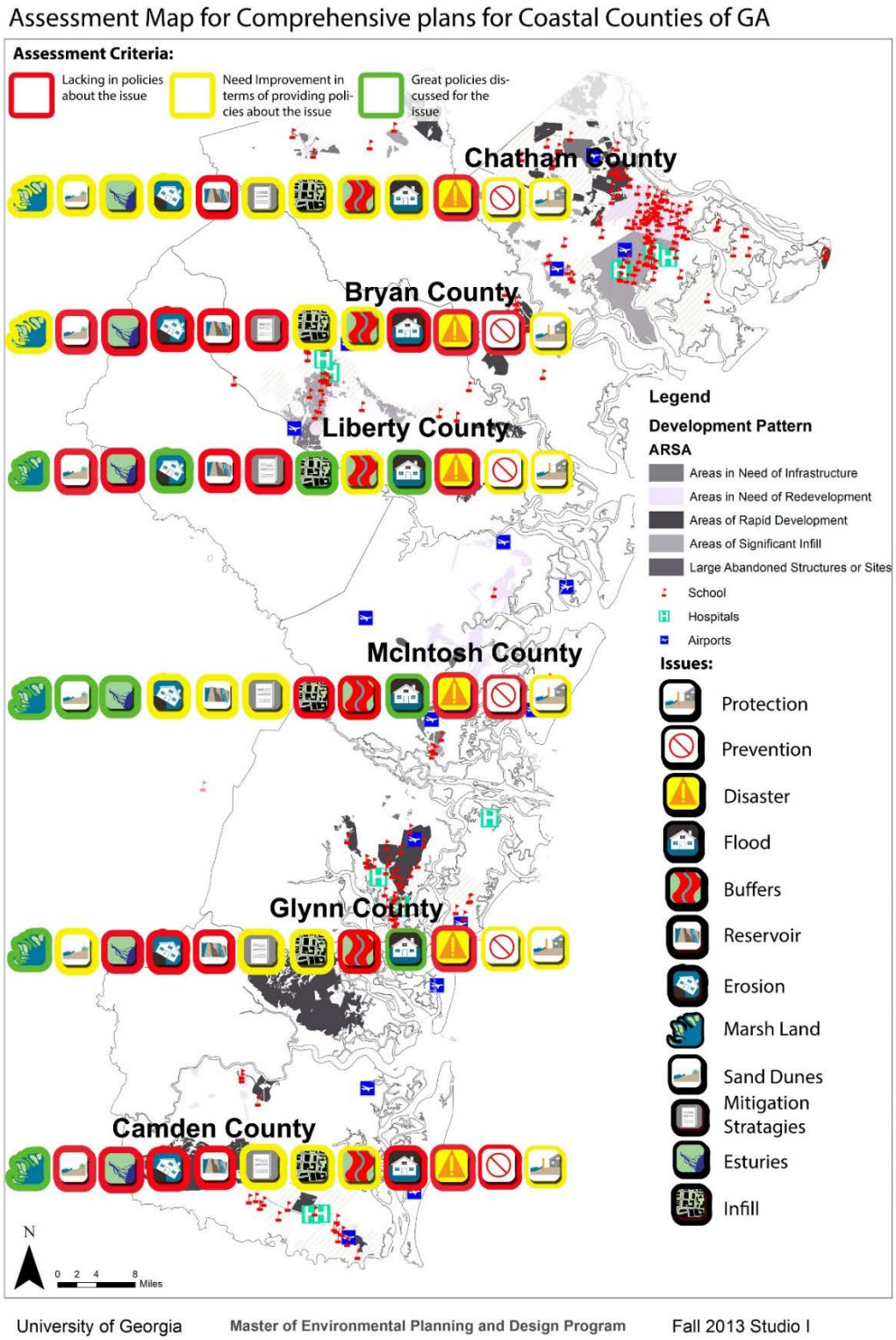
NOTE: All the assessments were done on the basis of available resources. Low rankings in any categories for counties can also be a result of missing or inaccessible data.

	Camden	Bryan	Chatham	Glynn	Liberty	McIntosh
Have a building construction code						
Compliance with FEMA						
1) Designation of conservation areas.						
2) Consideration of Flood Plain Elevation						
3) Identification of Different Flood Zone						
4) Relocation\Alteration of Utilities like Water lines, gas lines						
5) Foundation specifications						
6) Lowest floor level						
7) Bottom horizontal structure level						
8) Construction below base flood elevation						
9) Enclosures below BFE (Base flood elevation)						
10) Addition and Reconstruction						
11) Building form						
12) Construction Standards and material						
Documents Reviewed	**Camden unified development codes**	**Bryan county building code ordinances, Bryan County Engineering Design Standards**	**Flood damage Prevention Ordinance**	**Comply with Flood plain Management in Georgia by Georgia department of Natural Resources**	**liberty county chapter , Building construction and other activities**	**No specific documents available**
No of Pages	**570**	**27, 128**	**23**	**76**	**103**	**0**
Special Notes	-	-		**No specific ordinance found in Glynn County Website, but it seems to comply with GDNR.**	**Compliance with : 1) International Building Codes 2) International Mechanical Code 3) International Gas Codes 4) International Plumbing codes 5) International Electrical Code 6) International Fire prevention Code**	**Couldn't Find any document specifically dealing with or explaining the construction codes.**
RANKING	3	2	3	3	1	1

	Not in compliance with FEMA's Document
	Have discussed but not in detail
	Comply with FEMA's Building Code

Table1.5.5. Chart that refers to different documents relating to building construction codes and compares it with FEMA's guidelines to assess the missing gaps for each county.

Maps



Map 1.5.1. Visually represents the assessment of different comprehensive plans for each counties and the missing gaps for each county.

Conclusion

Comprehensive plans, community agenda and hazard mitigation plans

Though the individual city plans are assessed, the results are examined on a county scale. McIntosh County scores the highest on the assessment of the County Comprehensive Plans & Community Agendas. Liberty scores the second highest followed by Chatham, Glynn, Camden, and finally Bryan county. The three counties with updated Hazard Mitigation Plans receive the same overall ranking.

There are many common gaps in the County Comprehensive Plans, Community Agendas, and Hazard Mitigation Plans. The majority of the County Comprehensive Plans and Community Agendas lack specificity when addressing concerns related to infill development, the presence of aquifers and/or reservoirs, and shoreline, riparian and estuary protection. In the three available hazard mitigation plans there is little to no mention of aquifers or reservoirs. Furthermore, major issues related to protecting vulnerable areas from potential hazards are ignored. In all three of the available Hazard Mitigation Plans there is a necessity for more detailed plans relating to the protection of estuaries, wetlands, and riparian and coastal zones.

2.0 Proposals and Programs

Environmental Performance Standards

Based on the vegetation/open water buffers each county may be awarded points founded on policies that protect riparian buffers. For example, a point value will be given to counties with policies that protect 100-feet from all hydrological features (water and wetlands). Additional points can be given for every 50-foot above the 100-foot buffer. So the 100-foot buffer will have the ranking of 1 since that is the minimum buffer width recommended and the 200-foot awards the number 3, the maximum.

Buffers

- Performance standard = 1 point, if county has a policy in place that enforce the protection of a 100 foot riparian zone around all open water, rivers, and wetlands.
- Performance standard = 2 points, if county has a policy in place that enforces the protection of a 150-foot buffer.
- Performance standard = 3 points, if county has a policy in place that enforce the protection of a 200 foot riparian zone around all open water, rivers, and wetlands.

Critical habitat (G-ranks) near conservation land and water recharge areas

- Performance standard = 1 point, if short term work program takes inventory of critical habitats near conservation land and water recharge areas
- Performance standard = 2 points, if program/policy is in place that acquires public and private areas that are near critical habitat/water recharge and connects them with existing conservation/protected lands

Additionally, counties could acquire riparian zones/wetlands/marshes (i.e. through simple purchase or by donations of easements) to supplement existing protected areas. These lands will supplement drainage and help slow flooding into developed areas. They will be allowed to maintain their natural state either through inundation or conversion to wetlands. Each county can also be awarded points based off if they gather information about disturbed wetlands and riparian zones.

Disturbed wetlands

- Performance standard = 1 point, if a short term work program takes inventory of disturbed wetlands
- Performance standard = 2 points, if a program is in place that actively restores disturbed wetlands through public volunteering and outreach with environmental non-profits

Mitigation and adaptation plans need to be in place to protect and restore natural resources within riparian buffers. In turn, each county can identify areas of rapid development that are encroaching on these buffers. Each county should consider a "cap" on how much development is occurring within these riparian buffers and projected storm surge zones. County policies should encourage development that is outside of these riparian buffer/storm surge zones. Alternatively, each county should consider infill or developing lands that are not within these areas.

Rapidly Developing Areas

- Performance standard = 1 point, if policy or program identifies areas of development within critical riparian buffers (100-200 foot buffer), inundation zones, and critical habitat areas (G-rank and water recharge areas)
- Performance standard = 2 points, if incentives are in place to promote infill and new development away from identified critical areas like riparian buffers and critical habitat areas

Lastly, by identifying critical habitats that are not currently protected or within conservation areas, each county can start considering how to connect these habitats to existing conservation land. By conserving these environmental assets, each county is meeting mitigation and other community objectives such as protecting sensitive habitat and providing parks and trails for tourism.

Social and Economic Programs

When handling a catastrophic event, it is necessary for local governments to have a plan to effectively engage the community. Communities at risk should be a top priority for any local government. Therefore, it is recommended that local governments recognize those communities at risk and have programs in place to effectively manage their special needs in a time of crisis.

Communication with businesses

- Engage in business continuity planning.
- Offer courses that help local businesses plan for catastrophic events through small business administrations.

The newly revised Federal Flood Insurance program is expected to have an immediate effect on coastal communities. To best prepare for this event, communities should work with FEMA to improve their physical resilience of the structures people and businesses reside in. This will drastically improve the insurance rates for those affected as well as improve the physical

resilience of a community. There are three primary recommendations applicable for improving the physical resilience of the study area; protection, accommodation and retreat.

Community Resilience Strategies

- Protection strategies--actions that keep rising water out of areas of risk.
  - Examples: construction of sea-walls, beach replenishment projects and shoreline armoring among others.
- Accommodation strategies-- actions that allow continued use of an area or structure without shoreline structures.
  - Examples: drainage improvement projects, raising buildings on pilings and flood-proofing.
  - Includes changes in behavior like evacuating early from flood prone areas and changing driving patterns to avoid frequently flooded roadways.
- Retreat strategies-- actions that plan for the eventual removal of structures and uses from an area that will be subject to inundation from sea level rise or storm surge.
  - Examples: relocation of infrastructure and flood prone buildings inland, purchase of land or conservation easements in at-risk areas and siting new structures outside of vulnerable areas.

In order to employ any of these strategies, existing programs, plans, policies and funding mechanisms in the state must be investigated for their ability to support adaptation actions.

Infrastructure Proposals

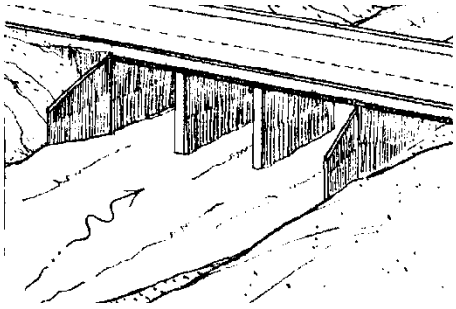
The following list contains suggestions, strategies, and solution for improving infrastructure resilience.

- Check for funding from FEMA Hazard Mitigation Assistance program. The chart below describes projects that may be eligible for funding:

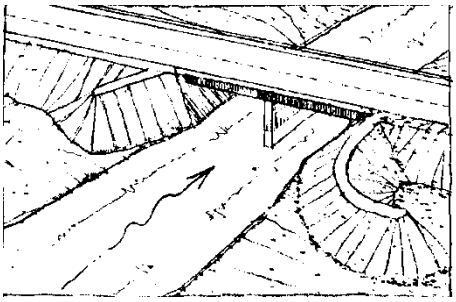
Structure and Infrastructure Projects	These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards. Many of these types of actions are projects eligible for funding through the FEMA Hazard Mitigation Assistance program. *Task 9 – Create a Safe and Resilient Community* provides more information on these programs.	• Acquisitions and elevations of structures in flood prone areas • Utility undergrounding • Structural retrofits. • Floodwalls and retaining walls • Detention and retention structures • Culverts • Safe rooms

- Prioritize critical infrastructure within each community that are at highest risk based on vulnerability rating.
  - Retrofitting, updating old structures, elevating structures, new construction
  - Use age, condition, level of use, and other standards to help determine priority
  - Create a cost-benefit analysis for mitigating infrastructure to evaluate which structures would be the most cost-efficient to invest in protecting.
- Develop mitigation strategies to protect bridges in high-risk areas, especially those located along major arterials and evacuation routes
  - Elevate structures where funding is available
  - Add vegetated banks along road shoulders to absorb flooding impact
  - Construct bridge wingwalls, spur dikes, or other similar structures to direct water flow

Vegetated banks: Vetiver System



Wingwall



Spur Dikes

- Clearly outline evacuation plans and post this information to the county or city website so that residents can easily access this information.

- In the emergency evacuation procedure section of the Hazard Mitigation Plan, specify that the emergency evacuation routes should be properly maintain and receive high priority for protection strategies.
- It is unclear whether or not port evacuation procedures are coordinated with the county. This information should be made more easily available. We checked Chatham and Glynn County websites, Savannah and Brunswick's websites, the Georgia Port Authority, as well as the Army Corp of Engineers Savannah District website, but did not find emergency evacuation plans clearly outlined in any documents.
- Do the emergency evacuation plans coordinate from one county to another? This information was also unclear. Since these six counties comprise the Georgia coastal region, they should also coordinate such procedures as a region for safety and efficiency. In other states such as North Carolina, counties coordinate to ensure proper, efficient and safer mitigation and evacuation methods.
- Develop programs to educate public officials, local residents, tourists, and other community leaders about storm surge, hurricane threat, and sea level rise. Raise awareness of these threats so that community leaders understand the need to take action and political leaders can make advances to implement appropriate policies and ordinances.
- Update GIS data on the county website like Chatham and Glynn Counties currently do. With such data available, problems emanating from the coastal geography of the region can more easily be evaluated and solved.
- Make county websites more accessible, user friendly, and informative. See Chatham and Glynn Counties for examples. As our society relies more and more on online interaction, this would be a good investment.

Comprehensive Plan and Community Agenda Proposals

Counties and cities should consider the aforementioned guides created by GEMA, FEMA and the Georgia Department of Community Affairs. Most importantly, the FEMA Local Mitigation Handbook provides a step-by-step process to developing and adopting a quality mitigation plan. Once each county has updated their Hazard Mitigation Plan, efforts should be put forth to incorporate the strategies into the County Comprehensive Plan and Community Agenda. These efforts would contribute to the resiliency of the region.

The counties' plans can also serve as a guide for each other. While none of the County Comprehensive Plans and Community Agendas or Hazard Mitigation Plans is perfect, they can serve as an example for the other counties. Below is a table that identifies the plans that could be used as a starting point in each of the major topics addressed in this assessment.

	Best Examples from Comprehensive Plans and Community Agendas	**Best Example from Hazard Mitigation Plans**
Beach projection	Tybee Island Master Plan-Community Agenda	None
Buffer creation	Chatham County/Savannah-Tricentennial Plan Comprehensive Plan-Community Agenda	Chatham County
Riparian/ estuary protection	Chatham County/Savannah-Tricentennial Plan Comprehensive Plan-Community Agenda	None
Marsh/ swamp/ wetland protection	McIntosh & City of Darien Community Assessment Joint Comprehensive Plan	Camden County
Erosion/ Sedimentation Control	Liberty Community Assessment Consolidated Comprehensive Plan	Camden County
Flood/ Stormwater Preparedness	Brunswick Community Agenda	Chatham, Camden, and McIntosh Counties
Aquifer/ Reservoir Protection	McIntosh & City of Darien Community Assessment Joint Comprehensive Plan	None
Brownfield/ Greyfield Remediation Efforts and Infill Development	Liberty Community Assessment Consolidated Comprehensive Plan	Not applicable
Hazard Management	None	Chatham County
Mitigation/ Remediation Efforts	Brunswick Community Agenda	Chatham County

Table 2.1. Summary of best examples of county Comprehensive, Community Agenda, and Hazard Mitigation Plans.

In order to improve the resiliency of the coastal region of Georgia, it is highly recommended that the cities and counties improve the quality of their Comprehensive Plans and Community Agendas as well as their Hazard Mitigation Plans. Furthermore, actionable items should be included in all short term work programs. We suggest that at a minimum all plans utilize the best examples from neighboring cities and counties as a guide for future modifications (as seen in Table 2.1). To ensure the plans are of the highest quality, local governments should adhere to the framework established by the FEMA Home Builder's Guide to Coastal Construction and FEMA Local Mitigation Handbook.

NOTE: The Table 2.1 was created on the basis of available information. It does not specify that any county does not have plans for the particular section. The Plans might be available, but either the information was not available for review or needs to be updated with respect to the suggested best examples.

Building Construction Proposals

Utilizing FEMA, these are the basic considerations for coastal building construction that needs to be adopted by the local governments in their future construction activities. For more detailed standards refer to sections 1.2 to 9.2 of the Home Builder's Guide to Coastal Construction, FEMA technical fact sheet.

- Siting– Site buildings away from eroding shorelines and high-hazard areas.
- Building Form– Flat or low-sloped porch roofs, overhangs, and gable ends are subject to increased uplift in high winds.
    - Buildings that are both tall and narrow are subject to overturning. Each of these problems can be overcome through the design process, but each must receive special attention.
    - Choose moderate-sloped hip roofs (4/12 to 6/12) if possible.
- Lowest Floor Elevation– Elevate above the DFE (Design Flood Elevation) the bottom of the lowest horizontal structural member supporting the lowest floor.
    - Add "freeboard" to reduce damage and lower flood insurance premiums.
- Free of Obstructions– Use an open foundation.
    - Do not obstruct the area below the elevated portion of the building.
    - Avoid or minimize the use of breakaway walls.
    - Do not install utilities or finish enclosed areas below the DFE (owners tend to convert these areas to habitable uses, which is prohibited under the National Flood Insurance Program and will lead to additional flood damage and economic loss).
- Foundation– Make sure the foundation is deep enough to resist the effects of scour and erosion; strong enough to resist wave, current, flood, and debris forces; and capable of transferring wind and seismic forces on upper stories to the ground.
- Connections– Key connections include roof sheathing, roof-to-wall, wall-to-wall, and walls-to-foundation. Be sure these connections are constructed according to the design standards by FEMA. Bolts, screws, and ring-shanked nails are common requirements.
    - Standard connection details and nailing should be identified on the plans.
- Exterior Walls– Use structural sheathing in high-wind areas for increased wall strength. Use tighter nailing schedules for attaching sheathing. Care should be taken not to over-drive pneumatically driven nails. This can result in loss of shear capacity in shear walls.
- Windows and Glass Doors– In high-wind areas, use windows and doors capable of withstanding increased wind pressures. In windborne debris areas, use impact-resistant glazing or shutters.
- Flashing and Weather Barriers– Use stronger connections and improved flashing for roofs, walls, doors, and windows and other openings. Properly installed secondary

moisture barriers, such as house wrap or building paper, can reduce water intrusion from wind-driven rain.

- Roof– In high-wind areas, select appropriate roof coverings and pay close attention to detailing. Avoid roof tiles in hurricane-prone areas.
- Porch Roofs and Roof Overhangs– Design and tie down porch roofs and roof overhangs to resist uplift forces.
- Building Materials– Use flood-resistant materials below the DFE. All exposed materials should be moisture- and decay-resistant. Metals should have enhanced corrosion protection.
- Mechanical and Utilities– Electrical boxes, HVAC equipment, and other equipment should be elevated to avoid flood damage and strategically located to avoid wind damage. Utility lines and runs should be installed to minimize potential flood damage.
- Quality Control– Construction inspections and quality control are essential for building success. Even “minor” construction errors and defects can lead to major damage during high-wind or flood events. Keep this in mind when inspecting construction or assessing yearly maintenance needs.

  Where:
  - Design Flood Elevation (DFE): The elevation of the 100-year storm as defined in FEMA Flood Insurance Studies or, in areas without FEMA floodplains, the elevation of the 25-year storm, or the edge of mapped flood prone soils or similar methodologies.
  - Base Flood Elevation (BFE): The computed elevation to which floodwater is anticipated to rise during the base flood.

In order to reduce building damage during flood events and to have a better FEMA flood insurance rate, it is important to adopt the FEMA home builder's guide. For the existing building, owners can apply for the FEMA building repair and renovation grant. New construction needs to be designed as per FEMA's building specifications.

3. Conclusions

The conclusions of this study are intended to provide a brief summary and general guidelines per county, based on the assessment of current conditions (section 1), and the regional proposals contained in section 2. For this purpose, we grouped the highest probably natural hazards (flood and storm surges) as outlined in section 1, into 3 general scenarios, with a consistent definition to that presented in section 1.4 (infrastructure):

Scenario 1: correspond to the events of highest probability, which correspond to a tropical storm, and include flooding, with relatively limited storm surges and threads of inundation. The most critical infrastructure for certain counties may be inundated, even with this low rating. Since this scenario involves mostly flood damage possibilities, high attention should be paid to storm water management mitigation, to keep roads, houses and business from being flooded. Flood gates, such as those in Tybee Island, are a possible solution to managing flood water in a coastal community. Effectively managing flood water subsequently protects most other forms of critical infrastructure.

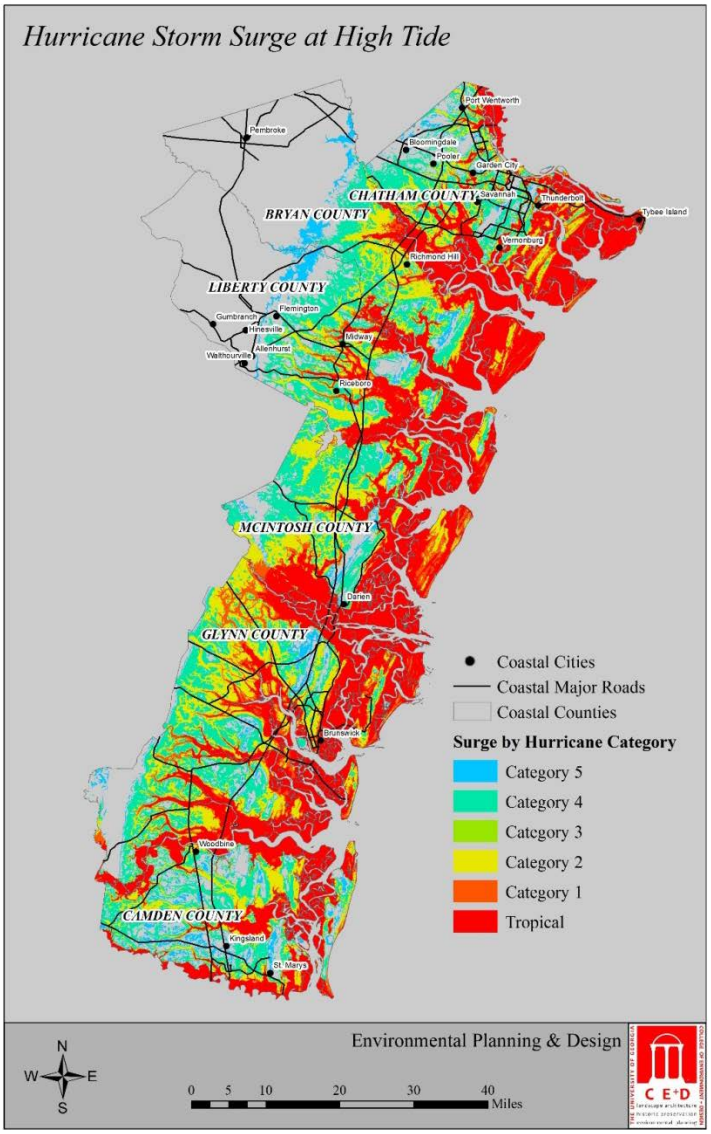
Scenario 2: correspond to events with a lowest level of probability but increased risk to those affected by Scenario 1. These include category 1 and 2 hurricanes that could represent a higher level of potential damage, due to storm surge and more extensive flooding.

> *"From the infrastructure perspective, Glynn and McIntosh counties obtained high vulnerability ratings, since the majority of their critical infrastructure may be affected. Chatham and Camden County have medium ratings, but could be considered high-risk since most of the population lives near a river or the ocean. Each of these counties also have inhabited barrier islands which should be marked as highly vulnerable areas due to their limited access to the mainland. Though Liberty and Bryan County still show a "low" rating, they are vulnerable, as they serve as connection hubs between the northern and southern parts of the region, especially connecting the highest populated port cities of Savannah and Brunswick."*

Scenario 3: correspond to hurricanes category 3-5, that are the least probably in comparison with the previous ones, but pose the highest threat to the coastal region, because of the extension and the severity of potential damages. Though this scenario seems least likely than the others, it should be planned for and considered when updating existing infrastructure systems or building new ones. Planning for the highest level threat is an efficient mitigation strategy that increases overall resilience of this region.

Using the definition of these 3 scenarios and the assessment of vulnerable areas in conjunction with current planning documents and tools presented in section 1, and specifically in section

1.5 (built environment and current plans) what follows is an overall conclusion and prognosis, per county.



Chatham County

With a population of 279,093 habitants and an area of 632 sq. miles sq. miles this represents the most vulnerable county. The total area to be inundated under scenario 1 would be 128,957 acres, from which % would occur in already developed areas. The total population that could be affected in scenario 1 represents 60, 45% of the total county population. This county has been growing at the expense of the lowest lying areas surrounding the historical areas. However, from the summary assessment of comprehensive plans and other planning tools in the county (described in detail in section 1.5), these plans address the topic of hazard

mitigation and resilience, but could offer more improvement (by providing more policies related to hazard planning). However, clear policies related to protection of water resources for resilience, as well as disaster mitigation are lacking in these plans.

In the possibility of scenario 1 occurring, a total of more than 300 business and more than 3,000 employees would be directly affected (inside the county), with a total expected loss of $ 1,095,681,000 in sales. In addition, 7,678 households below poverty levels (11.8% of total households in affected areas) would require special attention.

Also, this county contains the most important communication infrastructure in the region, the port of Savannah and the commercial airport, becoming the most vulnerable area.

Bryan County

The second to lowest population in the region, with a total of 32,729 habitants, it is, on the other hand, the second largest in size (454 sq. miles). The total population that could be affected in scenario 1 represents 6.48% of the total county population (18,097). This is the second to last populated county, with a total of 32,729 habitants; with a relative lower impact that other counties in the region, in terms of socio-economic indicators.

A total of 402 households under poverty level would be affected under scenario 1 (out of 6273 households to be impacted under this scenario). In terms of economic impact, this would be relatively smaller, given that the total of businesses and employment in this county are 1,379 and 9,438, respectively, and from those, only 3 businesses would be located in the scenario 1 flood zone.

According to the summary assessment of comprehensive plans and community agendas in the county (section 1.5) gives a very low score, due to lack of addressing critical issues related to hazard planning and mitigation, such as flooding, aquifers, hazard, and other key elements.

Liberty County

From the total population perspective, Liberty is the 3rd county, with a population of 67,801 habitants, and total area of 603 sq. miles. However, from the impacted area perspective under scenario 1, this county would be the less impacted in the area, with a total of 57,808 acres to be inundated, and only 95 acres developed within this area, that contains a total population of 10,664 habitants (the smallest population to be impacted in the region), and total absence of businesses in this scenario 1 area.

From the total number of households located in areas to be impacted under scenario 1 (4,015) 566 are under poverty levels, and would need to be accounted for.
Contrasting with these numbers the assessment of comprehensive plans and community agendas gave very good numbers in this county (section 1.5). Issues of wetland protection,

erosion, and flooding, among others, have been extensively addressed in the Liberty Community Assessment Consolidated Comprehensive Plan. This plan has also address issues of brownfield/greyfield remediation, and therefore is listed as best example of plan in both topics.

Overall, Liberty County can be considered one of the top counties from this perspective, given that the quantified impact is one of the lowest, but on the other hand, plans address issues of protection and resilience effectively.

McIntosh County

The smallest county, in terms of population (13,970), with a total area of 575 sq. miles, this county represents the 5th county in terms of total population to be potentially impacted in scenario 1 (with 12,101 habitants located within these areas). The total developed areas to be inundated under this scenario occupy 222 acres (from a total of 110,599 acres to be impacted) representing 0.20% of the total county potentially affected area extension. In contrast, this county occupies the 3rd place in number of extension of wetland and other vegetated areas (99,441 acres) that represent almost 90% of the county. Other counties numbers fluctuate between 88% and 95% of vegetated areas within the scenario 1 total impacted areas, indicating that these areas could potentially buffer part of any potential flooding to the developed areas.

In the possibility of scenario 1 occurring, a total of 12,101 habitants could be potentially impacted, with 4,930 households, from which 1,016 are under poverty levels in these potentially impacted areas, representing the highest level of household below poverty level in the region, with a total of 20.61% of the total population in scenario area 1. However, in terms of business and employment the potential total loss would be $ 1,059,000.

Key issue in terms of impact for this county could be from the communication and transportation perspective, given that their main connector to the North and South is I-95, with a potential impact of

In terms of community agendas and comprehensive plans, the McIntosh & City of Darien Community Assessment Joint Comprehensive Plan addresses the needs of the county and the main city. This is the only county that addresses issues related to protection of aquifer, as well as wetland, soil, and flooding-related topics. Given that this county will receive one of the lowest impacts under this scenario, and that is has been well reviewed in their planning efforts, we think that this is one of the best ranked counties in the region.

Glynn County

Glynn represents the second county, population-wise, with a total of 81,258 habitants. It occupies a total area of 585 sq. miles. Although this is the 4th county in terms of total area to be inundated under scenario 1 (92,862 acres), it has the highest percentage of developed land to be impacted (1.64%, 1,521 acres) under this scenario, and it is the second county, in terms of total population to be impacted by scenario 1 (22.90%) of the total county population (63,000 habitants).

This county has developed both in inland and island areas (Brunswick, Jekyll Island, and St. Simon). Household poverty level percentage within the Scenario 1 impacted area is similar to Chatham (11.45%), representing the 3rd ranked counties in this category, with McIntosh and Liberty having the highest percentages (20.61% and 14.10% of the total households in these counties, for scenario 1).

In the possibility of scenario 1 occurring, a total of 261 business and 1773 employees would be directly affected (only within the county, not including indirect employment and those outside the county. However, in terms of total expected loss, this would be the second highest loss in terms of sales, with a total of $ 377,612,000 in sales.

Glynn County has to plans, the Glynn County Comprehensive Plan Update, and the Brunswick-Community Agenda, that address issues related to wetland protection and flooding. However, the topic of hazard mitigation and resilience, could offer more improvement (by providing more policies related to hazard planning). The review of the Brunswick- Community Agenda indicated topics of Flood & Stormwater Preparedness, and Mitigation/ Remediation Efforts, as models for the rest of the region (table

In terms of transportation and communication, this county contains the second most important communication infrastructure in the region, the port of Brunswick and local airports, becoming the second most vulnerable area from this perspective, after Chatham County.

Camden County

Camden represents the 3rd county in the coastal population ranking, with a total of 51,300 habitants, and one of the largest counties occupying a total of 783 sq. miles. It also represents the 2nd county in the region, in terms of total area to be inundated (115,333 acres) under scenario 1. Fortunately, a good percentage of developed areas in this county, with the exception of St. Mary, are located inland, with 521 acres of developed area to be impacted under scenario 1.

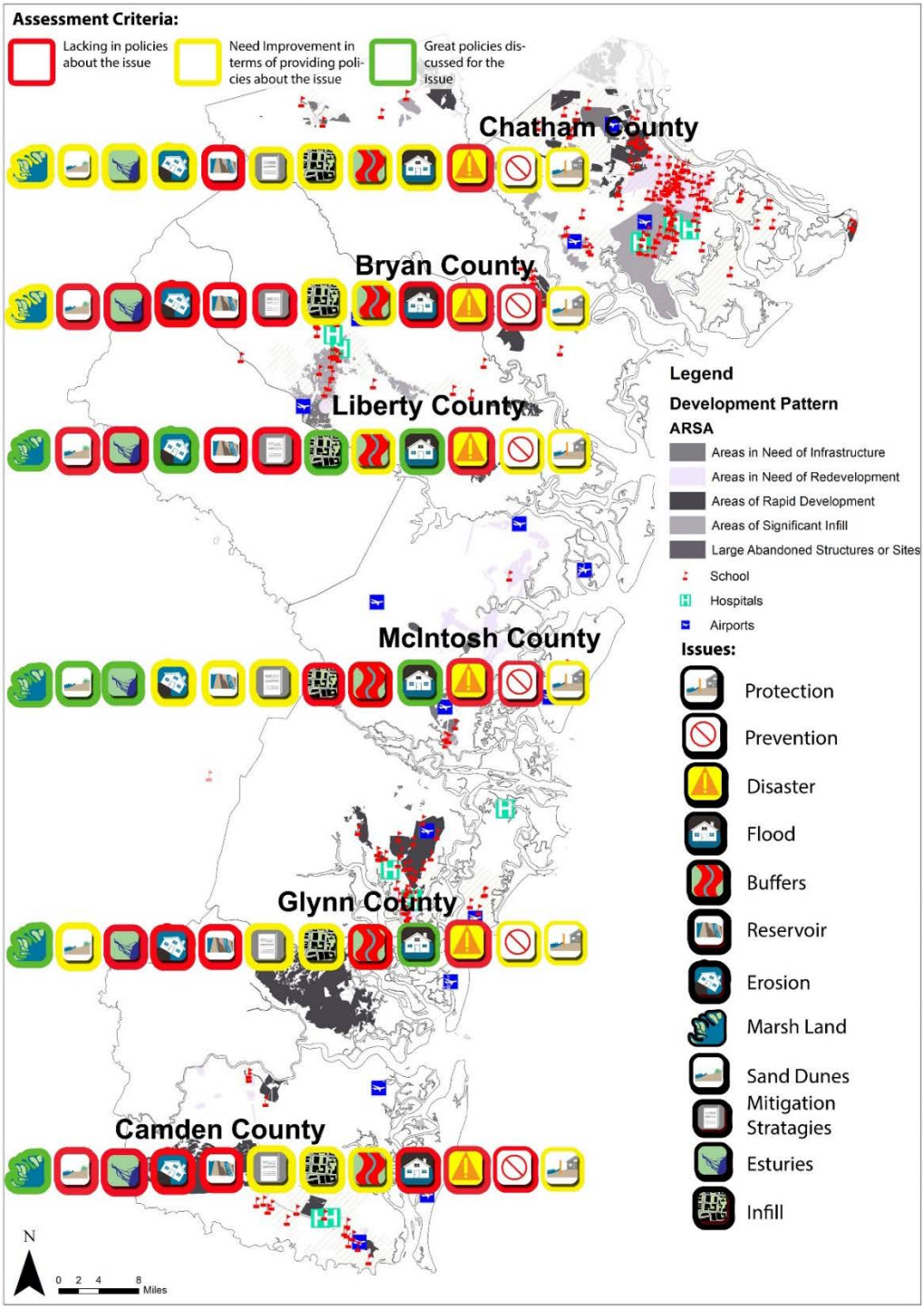
In terms of population, 12.87% of the households under poverty level (2,407 habitants from a total of 18,704 habitants) are located currently under scenario 1 areas (3rd in the region after McIntosh and Liberty).

In the possibility of scenario 1 occurring, a total of 37 business and 263 employees would be directly affected (only within the county, not including indirect employment and those outside the county. In terms of total expected sales loss, this would be the third highest loss in terms of sales, with a total of $ 66,506,000 in sales.

Camden County has the Camden- Joint Comprehensive Plan, but this plan has limitation in addressing issues related to wetland protection and flooding On the other hand, this is one of 3 counties (with Chatham and Liberty) that have Hazard Mitigation Plan, and along with these plans, address the topics of Flood/ Stormwater Preparedness, as well as marsh protection, and erosion/sedimentation control.

In terms of transportation and communication, this county has a direct route for communication to I-95 that connects to Florida and inland areas.

Assessment Map for Comprehensive plans for Coastal Counties of GA



University of Georgia Master of Environmental Planning and Design Program Fall 2013 Studio I

Socio-Economic

Scenario 1: Tropical Storm								
County	**Households in Poverty**	**Population Over 75**	**Children Under 5**	**Total Population**	**Households**	**# of Businesses**	**Sales**	**Employees**
Chatham	7678	94103	11983	168707	65169	359	1095681000	3335
Liberty	566	5834	552	10664	4015	0	0	0
Bryan	402	9824	1162	18097	6273	3	1337000	7
McIntosh	1016	4930	732	12101	4930	5	1059000	10
Glynn	2930	36711	4075	63911	25585	261	377612000	1773
Camden	2407	28927	3813	51300	18704	37	66506000	263

Scenario 2: Hurricane Categories 1 & 2								
County	**Households in Poverty**	**Population Over 75**	**Children Under 5**	**Total Population**	**Households**	**# of Businesses**	**Sales**	**Employees**
Chatham	11507	86965	15920	226362	86965	3120	8562608000	31049
Liberty	930	9475	1254	17648	6549	169	845096	1659
Bryan	593	11601	1427	21479	7640	578	1148341000	3968
McIntosh	1165	8059	792	13817	5687	62	29994000	248
Glynn	4250	44129	5209	77632	30617	4132	28826522	44766
Camden	2858	31630	4310	56872	20756	374	323251000	2389

Scenario 3: Hurricane Categories 3, 4 & 5								
County	**Households in Poverty**	**Population Over 75**	**Children Under 5**	**Total Population**	**Households**	**# of Businesses**	**Sales**	**Employees**
Chatham	14849	139587	17879	251259	98043	13139	32351377000	132194
Liberty	1511	15004	3064	28736	10071	488	1125760000	4680
Bryan	632	12795	1638	23830	8497	1001	1781417000	7020
McIntosh	1165	8059	792	13817	5687	567	852750000	3504
Glynn	4250	44129	5209	77632	30617	5714	10121749000	59089
Camden	2858	31630	4310	56872	20756	1758	2306748000	22857

Natural

Scenario 1: Tropical Storm		
County	Development within Innundation Zones (Acres)	Vegetation within Innundation Zone (Acres)
Chatham	1119/128957	114037/128957
Liberty	95/57808	51048/57808
McIntosh	222/110599	99441/110599
Glynn	1521/92862	85793/92862
Camden	521/115333	109042/115333

Scenario 2: Category 1 & 2 Huricane		
County	Development within Innundation Zones (Acres)	Vegetation within Innundation Zone (Acres)
Chatham	3195/57217	31778/57217
Liberty	498/43412	37699/43412
McIntosh	515/72118	66304/72118
Glynn	2587/102147	74353/102146
Camden	1000/84322	72922/84322

Scenario 3: Category 3, 4, & 5 Hurricane		
County	Development within Innundation Zones (Acres)	Vegetation within Innundation Zone (Acres)
Chatham	1779/86806	45966/86806
Liberty	660/101695	86939/101695
McIntosh	225/86191	76426/86191
Glynn	669/68431	49754/68431
Camden	1779/86806	156111/177680

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PLANNING WITH CLIMATE: URBAN DESIGN AS A TOOL FOR ADAPTATION

by

MARIANA BARRETO ALFONSO

(Under the Direction of Rosanna G. Rivero)

ABSTRACT

This thesis focuses on the interactions between the urban environment and climate. Using the city of Savannah, Georgia, as a case study, the main goal of this project is to demonstrate how urban design can impact climate, displaying the importance of the acknowledgment of this issue by the planning community. Furthermore, it aims to display how basic knowledge of climate can become a powerful tool for the conception of urban design and aid in adapting cities to climate, in a time when resiliency and adaptation are at the forefront of the discussions in many fields. The results of this study will potentially help shed light to the applicability of climate in planning and point to a practical approach to the incorporation of this theme in city plans and policies.

INDEX WORDS: urban design, climate adaptation, urban planning.

PLANNING WITH CLIMATE: URBAN DESIGN AS A TOOL FOR ADAPTATION

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A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial

Fulfillment of the Requirements for the Degree

MASTER OF ENVIRONMENTAL PLANNING AND DESIGN

ATHENS, GEORGIA

2014

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PLANNING WITH CLIMATE: URBAN DESIGN AS A TOOL FOR ADAPTATION

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DEDICATION

This thesis is dedicated to my parents, Marcio Renato Alfonso and Ana Maria Alfonso, for their love, support and for inspiring me to believe in the power of hard work and dedication. And to my husband, Breno de Oliveira Fragomeni, for embarking on this journey with me and lovingly helping me make this dream come true.

"We shall never achieve harmony with land, any more than we shall achieve absolute justice or liberty for people. In these higher aspirations, the important thing is not to achieve but to strive."

(Aldo Leopold)

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I thank you all so very much, for helping make this dream a reality.

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CHAPTER 1

INTRODUCTION

Coastal areas, the seemingly most vulnerable areas to climatic change and greatly pressured by real estate development, have begun to demand that planning professionals look at issues related to climate and have displayed what could be a shift in how planning is practiced in the future. Changes being made to the United States Federal Flood Insurance have recently greatly affected coastal communities and have demanded plans that look closely at the issues of stormwater management and sea level rise. These, in turn, are directly correlated to climatic issues and have gained public interest, for the effects are clearly observable. Unlike pollution dispersal, thermal comfort, and wind patterns, precipitation is visual and the impacts of an occurrence, such as flooding, is easily perceived. Such scenario poses a unique opportunity for the incorporation of climate to the planning process, as cities strive to adapt in order to maintain the affordability of flood insurance policies in the short term, but most importantly, to endure the climatic impacts that could come ahead.

The concept of incorporating climate as a design tool is not new to other profession such as architecture and civil engineering, which have long used climatic knowledge for the creation of energy efficient buildings and generating thermally comfortable indoor environments. Studies in these areas of expertise, have developed metrics and

created guidelines that translate the goals designs must achieve, in order to adapt to climate.

Yet while architects and engineers drill further into developing climatically adapted buildings, the approach to climate is site specific, addressing but a small portion of a much bigger sphere, the city. In that sense, urban designers have remained rather dormant towards the subject of climate planning and design and are now being brought to the conversation of climate adaptation. With this in mind, this thesis aims to address how planners can incorporate climate as a successful urban planning design tool. Looking at the architectural and engineering design guidelines as a starting point to the development of standards focused on the adaption of cities for the future.

Objective

The main objective of this thesis is to define how urban form impacts climate and how design could aid the process of adaptation. In order to achieve this objective the following issues will be addressed:

1. How climatic factors, combined to the physical landscape characteristics interact.
2. What are the different climatic responses between the built environment and the natural landscape.
3. Identify the key climate factors that have direct impact in climatic perception and effect comfort.
4. Examine design solutions that could improve the effects of the built environment on climate.

CHAPTER 2

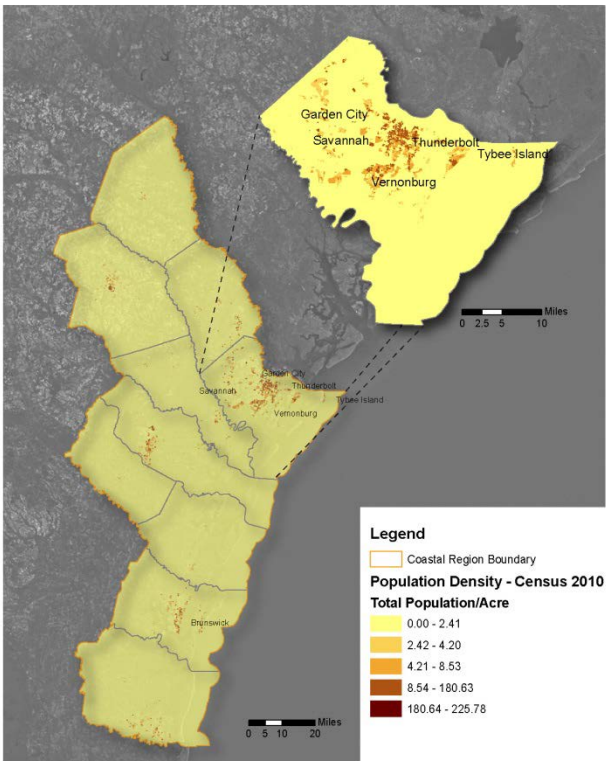
CASE STUDY: SAVANNAH, GA

"*The Town of Savannah is built upon an open sandy plain, which forms a cliff, or, as the Americans term it, a bluff by the shore, about 50 feet [15 m] above the level of the river. It is well laid out for a warm climate, in the form of a parallelogram, about a mile and a quarter long [1.6 km], and half a mile wide [0.8 km]. The streets are wide and open into spacious squares, each of which has a pump in the centre, surrounded by a small plantation of trees.*" (de Vorsey apud John Lambert, 2012).

To design with climate one must first understand climatic behavior and its relationship with the urban form. With that in mind this project aims to address the possibility of incorporating climate analysis in the urban planning process as a way of guiding design choices. To demonstrate the issues at hand, this thesis uses the Georgia Coast, in the United States, as a study case. More specifically it looks closely at the city of Savannah, seeking to further analyze how the subject of climate could be incorporated into future plans and aid the city in adapting to possible climatic changes.

The choice of Savannah as a study case, was made for two reasons. Firstly for being the most urbanized area within the coast of Georgia, with significant growth in the past years, as will be presented in the Analysis Chapter of this thesis. Secondly, due to its historic downtown, which presents a unique opportunity to understand the effects of open spaces and tree cover within dense urbanized areas. Additionally, unlike most

parts of the Atlantic Coast of the United States, the Georgia Coast has remained fairly undeveloped until now. With that in mind, the use of the city of Savannah as an example of how a more urbanized city could be planned would set an example and aid for more audacious measures in less developed cities along the coast, securing not only resiliency to the community but also to the existing natural environment.



City of Savannah

The city of Savannah, Georgia, was founded in 1733, on the margins of the Savannah River, approximately eighteen miles away from the Atlantic Ocean and was planned by its founder, General James Edward Oglethorpe. The basic plan consisted of a ward system, 600 feet in the north-side direction and approximately 600 feet in the east-west directions. Each ward was designed as a neighborhood, in which buildings and

streets faced a square and allowed for a connection between urban and green infrastructure. In modern times, such design has adapted successfully to the use of vehicles, while still allowing for a pedestrian-friendly environment.

Savannah's Historic District is resilient[1] by nature, planned as the result of an analysis of its surrounding, and more importantly its natural environment. Oglethorpe surveyed the region, observed its natural features and strategically laid out a plan in higher grounds, which would in turn not only keep its inhabitants safe from possible invaders, coming from the river, but also from diseases, such as Malaria, and more importantly from flooding. As a result, such meticulous planning with the environment enables the Historic District to be above water even under a category five storm surge.

Yet as Savannah grew outside of its original plat, it took new form and as time passed and as population increased, like in most cities around the globe, the need to expand suppressed the limits imposed by the natural environment. Which meant that Savannah, populated its flood plains and urbanization reached all the way into the marshes. According to the US Census Bureau, in 2010 Savannah had a population of approximately 136,286 people, and estimated that by 2012 it had 142,022 people. A study by the University of Pennsylvania[2] (2006) forecasts, though, that by 2020 Savannah will have reached a population of approximately 414,895 people. Accounting for the fourth biggest city in the state of Georgia, Savannah is growing at a

[1] The meaning of resiliency in this context is the ability to recover from or adjust easily to change.
[2] This study was developed in 2006, with forecasts based on US Census data from the year 2000. Predictions account for only 75% of the variance in growth experiences between 1980 and 2000, with the other 25 percent explained by "surprise" events.

fast pace and needs to be weary of the quality of the urban environments being created as a result of its growth.

Analyzed Sites

In the attempt to better understand how urban design can use climate as a tool for planning, two sites were chosen within Savannah. The first site, situated within the Historic Downtown of Savannah, was selected as an example of a favorable approach to a climatically adapted urban design. Recognizing the importance of the squares in both providing shade and allowing for better ventilation, due to the dense tree canopy cover provided by the oaks that surround them. Moreover, the premise for choosing this site, allows for a better understanding of how planned open spaces can create pockets within the tight knit building network that surrounds it, which may allow wind flows to regain speed and also cause certain directionality within the street grid, theoretically reducing wind turbulence.

The second site selected, was chosen due to its apparent disfavorability, but yet for its potential for being transformed, taking into account that the intention of this project is not only to observe the impacts of urban design choices to climate, but also attempting to suggest strategies for redesign, in order to demonstrate how the basic understanding of climate can serve as a tool for planning. Situated in a growing area of the city, this site has a few lots still for sale and development seems to be occurring at a fast pace. It has attracted some car dealerships, shops, office buildings, storage spaces and is in close proximity to some residential development.

CHAPTER 3

METHODOLOGY

The methodological approach of this thesis takes into account the analysis of the current physical conditions of the case study area in three different scales:

- Regional Scale - defined by the political boundaries that delimit the counties under the administration of the Georgia Coastal Regional Commission, with specific emphasis on Chatham County;
- City Scale - defined by the boundaries of the city of Savannah;
- Site Specific Scale – two sites selected within Savannah, with the objective of comparing the original city plat design to new urban development in its outskirts.

Themes	Regional	City	Sites
Landscape and Natural Environment	Topography Land Cover Vegetation	Topography Vegetation Solar Radiation	Open Spaces
Flood, Wind, and Stormwater Management	Floodplains Surge Maps Wind Patterns	River Basins Flood zones Wind Speed and Direction Solar Radiation	Wind Turbulence
Development Patterns	Built Density	Future Land Use Land Use Zoning	Impervious Cover Building Height

The purpose of evaluating the studied area in three scales is to cross-reference the landscape to climatic characteristics, in other words, map the physical aspects and evaluate the impacts to climatic responses, looking closely at solar radiation and wind flow. The regional scale analysis looks at understanding the broad context in which Savannah is inserted in, including an evaluation of the design strategies suggested by the United States Department of Energy for the climatic zone in which the state of Georgia is inserted in. The city scale was used to determine the chosen sites and also to analyze climatic behavior, based on data collected from the Savannah International Airport, weather station 722070. Lastly the analysis compares the responses obtained from the selected sites, contrasting issues that arise from both wind flow and solar radiation. This document will then discuss how the analysis could aid in the development design strategies and performance standards that could serve as guidelines for planners within coastal communities such as Savannah.

Regional Scale

Using Geographic Information System (GIS) software, the regional analysis consists of an overlay of maps that enable a thorough understanding of the characteristics of the landscape. Initially, United States Census block data was used to determine the area with the most demographic concentration, which led to the choice of Savannah as the actual study area. Once that was established, the analysis then focused on understanding the interrelations between Savannah and the region, seeking to identify characteristics of land cover, floodplains, and urban growth patterns that could collaborate to climate change. Mapping wind patterns in this section was

particularly difficult due to the lack of available to data pertaining to directionality and speed. Data found covered the whole country, and data specific to the state of Georgia and the coastal region focused solely on wind speed.

City Scale

From the GIS analysis stand point, the transition from regional scale to city scale is subtle, focusing on capturing the increase in buildings over a 27 years span and identifying the direction of growth within the city boundaries. This analysis set the foundation for determining the two sites to be evaluated in the next phase, aiming to compare climate interactions within the historic downtown urban network and a recently developed area. In this scale climate data was incorporated, using the Climate Consultant 5.5 software[3], with some auxiliary analysis done using Ecotect Weather Tool. In both, programs a Typical Meteorological Year 3 (TMY3)[4] data set, retrieved from the Savannah International Airport weather station, is used as input to generate graphics and charts that display the characteristics of the climate during a typical year, in other words, overlooking extreme weather events. It is important to point out that both Climate Consultant and Ecotect are software created and used for building simulation, yet it is the intent of this study to demonstrate that such tools could be

[3] Climate Consultant 5.5 is software developed by University of California's Energy Design Tools Group.
[4] TMY3 is a data set of hourly values of solar radiation and meteorological elements for a 1-year period, developed by the National Renewable Energy Laboratory. It is widely used in computer simulations of solar energy conversion systems and building systems to facilitate performance comparisons of different designs, and locations. They represent typical weather conditions and are not used to simulate extreme weather occurrences.

adapted to suit the urban design needs and could also serve as initial guiding factors for the proposal of design solutions.

Site Specific Scale

As previously mentioned, two sites were selected within Savannah, as a way of drawing comparisons between the climatic interactions in the historic district, representing the Oglethorpe Plan, and recent urban patterns formed in newer areas in the city. The choice of Wright Square was due to its relatively central location within the historic district, allowing for an evaluation of effects of surrounding squares on the studied site, particularly looking at wind flow. The second site was derived from the overlay of built environment maps from 1985 and 2013, seeking to look at development that occurred in recent times, thus representing contemporary form of urban growth patterns. Once both areas were defined a quarter mile radius was designed, stipulating the area as a parameter for comparison of both sites.

For this scale, analysis consisted of creating 3D models of both sites, using AutoCad software, which were then simulated in Autodesk Vasari and Ecotect software for the interpretation of possible wind and radiation responses in both sites. This section was the most challenging, as both software programs, though powerful bioclimatic design tools, are intended to simulate performance of single buildings and their interactions with small clusters of buildings. The issue of scale in this case made both programs slow and generated several inconsistencies in results, generating a several delays and requiring constant revision of the results obtained.

CHAPTER 4

LITERATURE REVIEW

Looking back in time, before the advent of technology, it is clear how human settlements were developed in conformance to the natural environment, taking into account the characteristics of the land and its climate. In his book Architecture without Architects, author Bernard Rudofsky states "There is much to learn from architecture before it became an expert's art. The untutored builders in space and time – the protagonists of this show – demonstrate an admirable talent for fitting their buildings into the natural surroundings. Instead of trying to "conquer" nature, as we do, they welcome the vagaries of climate and the challenge of topography." Rudofsky (1987) Though very much focused on illustrating the different types of vernacular settlements, this book depicts a few examples of how climate and terrain determined where and how cities would grow.

The first historic recording of construction guidelines in ancient times are found in 1st century BC, a book written by Roman architect and engineer Marcus Vitruvius Pollio, rediscovered and translated during the Renaissance period, known as the book De Architectura. In its 6th Chapter Vitruvius states: "If our designs for private houses are to be correct, we must at the outset take note of the countries and climates in which they are built. One style of house seems appropriate to build in Egypt, another in Spain, a different kind in Pontus, one still different in Rome, and so on with lands and

countries of other characteristics. This is because one part of the earth is directly under the sun's course, another is far away from it, while another lies midway between these two. Hence, as the position of the heaven with regard to a given tract on the earth leads naturally to different characteristics, owing to the inclination of the circle of the zodiac and the course of the sun, it is obvious that designs for houses ought similarly to conform to the nature of the country and to diversities of climate." Though both Vitruvius and Rudofsky discuss specifically on the subject of Architecture it is safe to say that the impacts of sitting singular buildings results in a composition that is the urban form, thus the formed network would in fact be responsive to climate and terrain.

The discussion of urban form from the climate perspective is a complex one and there has been very limited literature produced by planners in the past, with the intent of truly depicting how urban design can be applied in order to reduce impacts to climate. Much of this resistance is a result of a professional trend that has led planners to refrain from taking a design oriented approach and focused more on the prescription of policies and the determination of suitable land-uses and the fragmentation of cities into zones. In her book *Arquitetura Bioclimática do Espaço Público* (Bioclimatic Architecture of the Public Space) Marta Bustos Romero names what are considered the predecessors to the subject of planning with climate. Introducing initially what she considers to be the three classic studies in the field and the precursors to what is the subject of climatic responsive design. The first one being the study developed by Hungarian architects Victor Olgyay and his brother Aladar Olgyay, who in the book

Design with Climate develop a regional approach to climate, a rational method of considering the variables of place and the conditions to defining settlements, into a quadripartite conception – climate – biology – technology – architecture. Later, in 1968, the brothers developed a bioclimatic graph in order to evaluate climatic elements (temperature, relative humidity, nebulosity, precipitation, wind and solar energy) with the built environment, taking a closer look at the relative importance of effects such as shading and radiation, created through this interaction. "With the registry of these elements, conditions of incorporating climatic recommendations exist with regards to site selection, urban fabric, public spaces, landscape and vegetation, in a general level, and as for housing typology, floor plans – form and volume, orientation and color of external surfaces – at a specific level" (Romero, 2001). The second study described by Romero was done by Israeli architect Baruch Givoni who took into consideration climatic elements, such as solar radiation, air temperature, wind, atmospheric humidity, condensation and precipitation to better understand the heat exchanges occurring between man and the environment, the physiological and sensorial responses to thermal pressure and the biophysical effects of environmental factors. Givoni, authored a book called Man, climate and architecture, in which not only does he describe the aforementioned findings but also looks at the relationship between the built environment and the direct effects of climatic variables, through thermophysical properties of buildings, such as thermal conductivity, conductance and surface coefficient. He also studied the applicability of design principals and material selection as a way of adapting buildings to climate, yet

recognized the impracticality of devising elements specific to each type of climate, due to variability, and thus proposed the application of principles in a macro level, for the following types of climate: hot-dry (desert), hot-humid (equatorial and maritime tropical) and mediterranean (subtropical). Lastly Romero mentions the studies developed by Povl Ole Fanger, an engineer who specialized in the interactions between man and the indoor perception of thermal comfort, an influential study which is used widely in the HVAC industry as a guide for controlling indoor temperatures.

Among the three classic studies suggested by Romero, two truly deal with the issue of urban design and climate, yet both in general terms, and with little recommendations from the perspective of form, as most of the design oriented guidelines focus on the prescription of solutions for new constructions and aim at production of comfortable indoor spaces. Romero expands her analysis and goes on to cite what she describes as the Climatic Lineage – Urban Climate group, in other words reflects on authors that have looked closely at the practice of urban design with a focus on environmental planning and the effects of urbanization on the atmospheric environment. The author goes on to mention a few precursors of this line of research, with emphasis on William P. Lowry a biometeorologist who wrote a book called Atmospheric Ecology for Designers and Planners with the purpose of closing the gap between the subjects of meteorology and urban design. She goes on to mention landscape architect Ian McHarg and urban planner Kevin Lynch as two important figures in the introduction of variables relative to terrain and natural resources in the planning practice as a form of

improving the urban environment. Yet she points out that Lynch's take on the subject emphasizes the image of the city as a form of interpretation and the orientation of the process of design, while McHarg looked closely at the natural environment and sought ways of defining solutions that promoted the conservation of green infrastructure. Romero also remarks the importance of the 1984 Urban Climatology Conference, held in Mexico City, which produced recommendations and proposals that were condensed in the 1988 WMO (World Meteorological Organization), n.652, and counted with the contribution of several world renowned authors, including Givoni, focusing on the urban design with climate, yet not taking into consideration solutions that sought to prevent only catastrophes resulting from natural disasters.

Though Romero names a considerable amount of authors, whose publications reiterate the preoccupation with the interactions and impacts of the urban environment and climate, it is quite clear that there still much to be seen on practical approaches to the subject. In fact, the author recognizes that most studies made on the subject of urban design focus very little on the complex problems inherent to it, preferring to discuss the ideology of relationships between individual buildings, neighborhoods and cities, but not truly diving into issues of form and design as problem solvers. "Jeffrey Cook (1991), for example, shows that the space in books dedicated by several authors to the theme of city planning and urban design is very small." As a footnote, she goes on to state: "To cite an example, Koenigsberger, Ingersol, Mayhew and Szokolay dedicate six pages out of 320 of the book Manual of tropical housing and building to the subject of settlement planning" (Romero).

The fact of the matter is that very little practical examples of the application of climatology in the city planning exist. The first known example of a plan with such emphasis was developed in Stuttgart, Germany. A particularly special project, thought to be one of the precursors to the incorporation of urban climatology into planning, with the introduction of an atmospheric meteorologist to the city's Environmental Planning Agency, in 1938. The concept of understanding the importance of climate in the planning process came as a way of guaranteeing the quality of life in cities, as with the increase in pollution in urbanized cities, there was an increased awareness on the need to secure the health of urban dwellers. With the beginning of World War I in the following year, the existence of a meteorologist among the team proved to be even more important, as fear of possible attacks using lethal gases demanded studies on wind patterns, leading to the understanding of how gases could dissipate within the urban form, through road networks and underground ventilation and pipelines. Such development led to a number of studies that determined how wind flows occurred within the city, as a result, by the time World War I and II were over, studies had enabled planners in Stuttgart to understand which areas of the city were particularly important in maintain and improving the city's climate. This is to date the most successful example of the incorporation of climate in urban planning, as the continuous study has led to the design of plans that allow the city to develop and grow while conserving areas and maintaining green infrastructure that are important for the improvement of the quality of life and ensuring less impacts to the city's microclimate.

The reasoning behind the incorporation of the subject of climate was rooted on both a meteorological and medical understanding. There is a context as to why Stuttgart was the first city to use urban climatology as a guide to planning for the future. In 1937, Pater Albert Kratzer published a book entitled "The Urban Climate", which focused on the influence the built environment can cause on air and climate quality. Kratzer's studies called the attention to the importance of the study of urban climatology and need to understand microclimates within cities. Immediately after World War I, tuberculosis became a severe problem in many countries in Europe, along with rickets, which affected particularly children due to a vitamin D deficiency, the outspread of such diseases pointed to, not only poor nutrition, but also environmental conditions factors to increase in the spreading of illnesses. Such observations allied with Kratzer's publications helped establish a demand for better illumination, ventilation and exposure to sunlight in cities and directly impacted the decision making in the planning realm.

Yet the issue at hand is not the importance of the incorporation of concepts of urban climatology into urban design, as it has already been establish, rather the discussion is why such subject has not been embraced by planners. Seeking to answer this question, a study in Sweden sought to further determine whether or not knowledge of climate was used by planners. The conclusion of such article stated that, "[t]he results showed that Climate Knowledge had low impact on the planning process. This proved the formulated hypothesis. However, a majority of the respondents say that they use climatic data. I think that this contradiction depends on the fact that most planners are

very uncertain about their own knowledge of urban climate" (Eliasson, 2000). In other words, it is not a matter of being unaware of the importance of climatic interactions in urban spaces, but the lack of confidence in applying such concepts and, furthermore, using this knowledge as a design tool. Therefore the question remains, as to whether or not there is a true way of using design as a planning tool that most definitely addresses climate and the natural environment. In order to bridge the subject of design and climate, one has to return to the question that our ancestors had to answer to build the first urban settlements, which is, how does the natural environment determine which places are suitable for development and how to conform the urban form to the existing terrain and climate?

However, the truth of the matter is that much has changed since the creation of the planning profession, and truthfully a planner can be guided by the understanding that climate and physical characteristics of the terrain can determine how land can be used, but is faced with yet a much bigger challenge, the fact that in many cases land that should not have been developed on is already built upon. In which case, in order to guarantee resilience, design must be an aid in the process of mitigation and solve problems caused or worsened by urbanization. Thus it is the interpretation of the impacts of the built environment on the natural environment, its resources and the climate and determining ways of restoring or reducing damages. In recent times, the vulnerability of cities has become more apparent, and planners have been pressured to take part in building what are called resilient communities. The term resilience planning comes from the science of Ecology and is considered by some ecologists "to

be a measure of how fast a system returns to a state of equilibrium after a disturbance; however, Holling (1973) defined it as a measure of how a system could be perturbed without shifting to a different regime. Walker et al. (2002) describe resilience as the potential of a system to remain in a particular configuration and maintain feedbacks, functions and an ability to reorganize following disturbance-driven change. It is the capacity of a system to experience shocks while retaining essentially the same function, structure, feedback and, therefore, identity (Walker et al. 2006)", though for both Eraydin and Tasan-Kok resilience "depends upon three central features of resilience (Berkes et al. 2003 : 6): (1) the ability of a system to absorb or buffer disturbances and still maintain its core attributes , (2) the ability of the system to self-organize and (3) the capacity for learning and adaptation in the context of change" (Eraydin and Tasan-Kok). The proposition of a new paradigm for planning is very interesting and demonstrates a new trend. The book Resilience Thinking in Urban Planning by authors Eraydin and Tasan-Kok display through study cases in Portugal, Sweden and the Netherlands, how cities are being planned using the methodology presented by resilience planning. Yet, while much of the analysis occurs through mapping and understanding the physical aspects of each city, determining what are constraints and opportunities, the end results are, for the most part, focused on the creation and change in policies, in other words, there is very little done from the design perspective, directly impacting form.

Coastal areas, the seemingly most vulnerable areas to climatic change and greatly pressured by real estate development, have begun to demand that planning

professionals look at issues related to climate and have displayed what could be a shift in how planning is practiced in the future. Changes being made to the United States Federal Flood Insurance have recently greatly affected coastal communities and have demanded plans that look closely at the issues of stormwater management and sea level rise. These, in turn, are directly correlated to climatic issues and have gained public interest, for the effects are clearly observable. Unlike pollution dispersal, thermal comfort, and wind patterns, precipitation is visual and the impacts of an occurrence, such as flooding, is easily perceived. With urbanization there are clear changes to the water cycle, the accumulation of water due to run-off is a consequence of the increase in impervious surfaces. During some rainfall events drainage and capture of water can become insufficient, as a result, flooding becomes recurrent and a constant cause for concern. The solution for such problems is in the hands of planners, not only in the determination of what areas can and cannot be developed on, but also in the creation and design of structures that can serve as capture points. Changes in street patterns and increase in vegetation can drastically reduce stormwater problems and can only be established through a carefully thought out plan and design concept. "Decentralized stormwater management approaches were identified as a way to recreate the natural hydrologic cycle promoting sustainable water resources and healthy ecosystems, (…) These and other [Green Infrastructure] GI practices retain stormwater close to its point of generation and release it at slower rate through infiltration into the soil, evaporation and transpiration into the atmosphere, and controlled release into the traditional gray infrastructure system. (…) GI reduces

runoff volume, peak discharge, and pollutant loading. Permeable pavement may have the longest record of documentation research among the variety of GI practices"(Burian & Pomeroy, 2010).

Stormwater Management and Green Infrastructure

The prospect of the incorporation of an issue such as stormwater management in urban design can also aid in the full commitment to the use of urban climatology as a tool for planning. Many other issues should be addressed in design concepts and plans in order to promote quality of life and attain truly resilient communities. Urban heat islands (UHI), for example, have been a phenomenon thoroughly observed and documented in urbanized areas, and there are reports pointing to the deadly effects of heat strokes caused by UHIs, posing a risk especially to children and elderly citizens. "For example, in 1995, a mid-July heat wave in the Midwest caused more than 1,000 deaths. While it is rare for a heat wave to be so destructive, heat-related mortality is not uncommon. The Centers for Disease Control estimates that from 1979 to 1999, excessive heat exposure contributed to more than 8,000 premature deaths in the United States.18 This figure exceeds the number of mortalities resulting from hurricanes, lightning, tornadoes, floods, and earthquakes combined" (Division, 2008). Not only that, but following the Stuttgart example, wind patterns need to be understood as well, from the formation of canyons along streetscapes to the dissipation of pollutants, physically mapping out the flow of air movement in urbanized areas can allow for the design of neighborhood parks, strategically planned

to support air flow and even limit the spacing and height of buildings in order to establish the continuous flow of wind through the urban network.

Truthfully, many solutions have been tested with successful results have been obtained in regards to increasing green infrastructure and stormwater management, yet little application has been seen with the use of the use of alternative materials, which could reduce radiation, or the use of vegetation as a form of maintaining wind flow within urbanized areas. While architecture has evolved in the design of net zero buildings, constructed with materials with low reflectivity and even incorporated aerodynamic features, urban planning timidly dabbles in the subject. Design wise, most solutions appear to be localized, implemented in small scale plans, such as neighborhood and very often in sub-division planning. In the larger scale, though climate may be taken into consideration in the analysis phase its implications lead to land-use related policies and future land use plans, that in some in cases are disregarded due to the fact that in many states in the United States such plans are not bound by law, but a mere guideline for local governments to use when found appropriate. The objective here is not to invalidate the importance of planning policies in the framework of urban planning, but yet to shed light on the need for the incorporation of design oriented solutions, particularly in the city scale, as a way of adapting urbanized areas to climate and attaining the formation of resilient communities.

CHAPTER 5

ANALYSIS & RESULTS

According to the climate region map[5] (Figure 1) developed by the U.S. Department of Energy's Building America Program, the state of Georgia can be characterized by two climatic regions: Mixed-Humid and Hot-Humid.

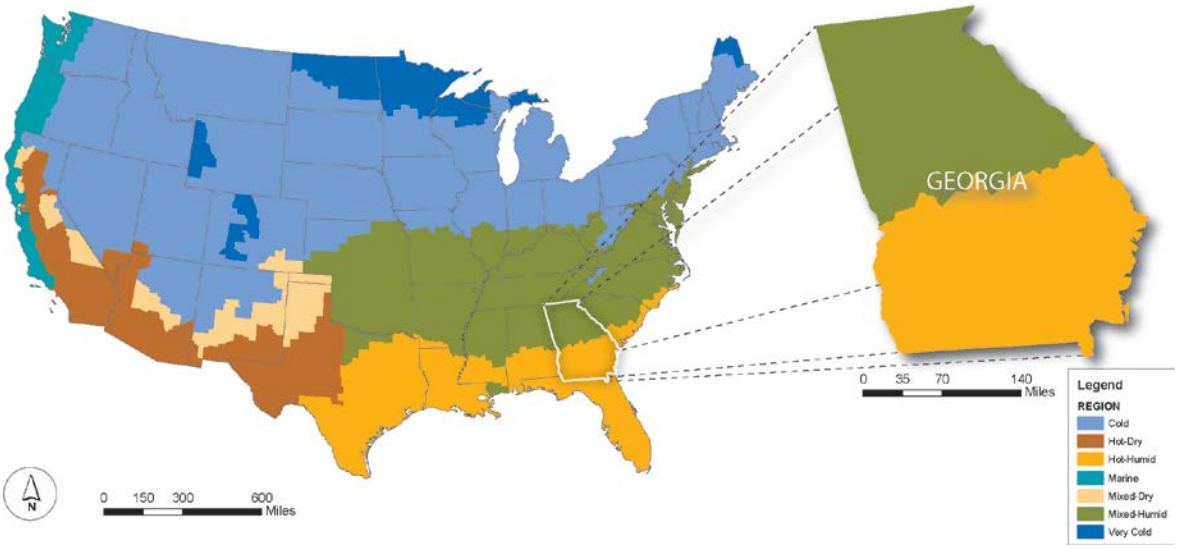


Figure 1 – Climate Zone Map, displaying classification for the state of Georgia within the context of the continental U.S. (DOE, 2011)

The coastal region of the state is characterized by a Hot-Humid climate, which in accordance to the Building America Program can be defined as "a region that receives more than 20 inches (50 cm) of annual precipitation and where one or both of the following occur:

[5] U.S. Building America climate regions are based on the climate designations used by the International Energy Conservation Code (IECC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). It intends to provide a simplified, consistent approach to defining climate for implementation of various codes; it was based on widely accepted classifications of world climates that have been applied in a variety of different disciplines. (DOE, 2010)

- A 67°F (19.5°C) or higher wet bulb temperature for 3,000 or more hours during the warmest six consecutive months of the year; or
- A 73°F (23°C) or higher wet bulb temperature for 1,500 or more hours during the warmest six consecutive months of the year." (DOE, 2011)

The understanding of climate region classification, from the architectural stand point, has been used as a form of establishing design guidelines, which can respond to the local climate, seeking to create an energy efficient and comfortable indoor environment. Such guidelines aid designers in establishing goals, and to a certain extent, simplify the incorporation of climate in the design process. From the urban design perspective, such guidelines have also been created, yet have not been widely incorporated by the urban planning community as an initial decision making factor.

In his book *Climate Considerations in Building and Urban Design*, author Baruch Givoni (1998) suggests that there are two types of issues to be considered in hot-humid regions: "minimizing the hazards of tropical storms and flooding and minimizing thermal discomfort and cooling energy consumption." He goes on to establish objectives for each of these issues, stating that the for hazards from tropical storms and floods urban design should focus on "minimizing the hazards of floods by water flowing in from areas beyond the city limits (mainly a location problem); rapid disposal of excess rainwater resulting from urbanization; providing rain protection for pedestrians in "commercial" streets." And finally for the issue of thermal discomfort and cooling energy consumption, he states that objectives should focus on "providing shade for pedestrians (on sidewalks); providing shade for outdoor activities, such as

children's playing areas; enabling good natural ventilation of urban space (streets, open spaces between buildings, public open spaces, and so forth); providing good ventilation potential for the buildings (airflow conditions around them); minimizing the "heat island" effect in densely built areas."

Such guidelines may seem broad, yet they are an initial starting point for designers to keep in mind while establishing their project objectives and developing plans for the future of cities. The analysis of the existing conditions in all three scales, will take these objectives into consideration, in an attempt to discuss what alternative decisions could be made to incorporate climate to future urban plans.

Regional Scale

As a starting point this phase of the analysis began by looking at the seasonal changes in wind flow and speed. Due to the lack of combined data available for wind directionality and speed, for the entire state of Georgia, and also seeking to understand where major wind currents were coming from, the wind analysis for this phase looked at the continental United States and then focused on the Southeastern portion of the country (Figure 2). In order to compare changes between Summer and Winter seasons, the maps looked at the months of June and December, as representatives of the specified seasons. It is important to point out, though, that changes in direction and speed do occur monthly, furthermore, the ruggedness of the landscape will influence and change these characteristics.

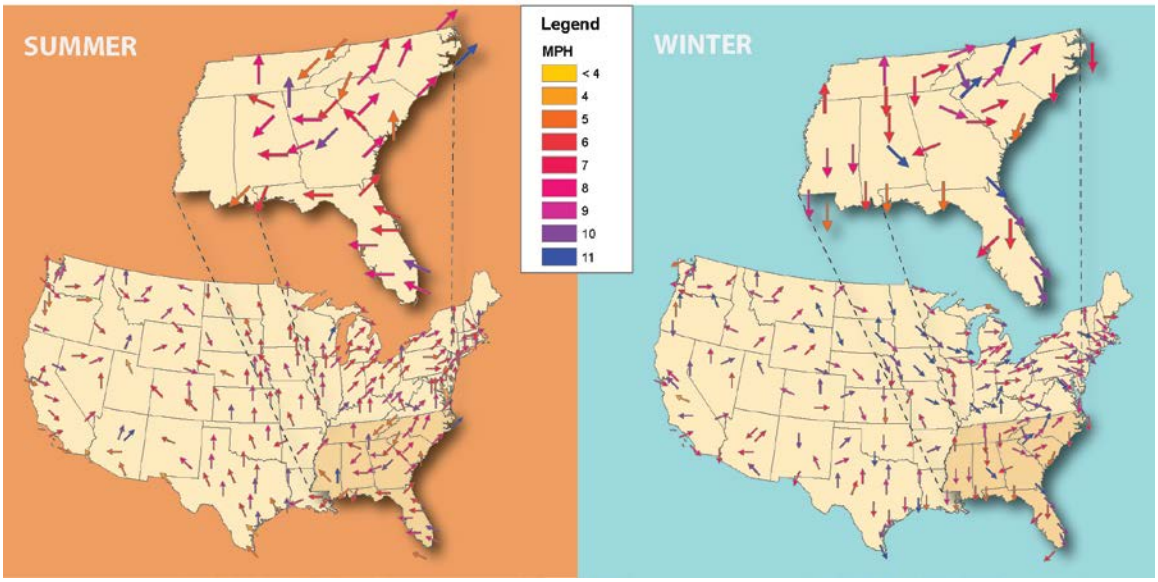


Figure 2 – Wind patterns in the continental United States, with focus on the Southeastern region, demonstrating changes in speed and direction between summer and winter seasons. (NOAA, 2012)

The generated wind maps demonstrate that wind directionality and speeds change significantly from summer to winter. During the summer prevailing winds tend to flow in a northeastern direction with an average speed of 7 mph, and apparently coming from the Gulf of Mexico, into Florida and Georgia. While during the winter prevailing winds flow towards the southeast, coming from the Carolinas and reaching an average speed of 5 mph.

The next step of analysis looked at land cover, utilizing Landsat 7 image to represent Normalized Difference Vegetation Index (NDVI) and the Normalized Difference Built-up Index (NDBI). The use of both indexes intended to visually demonstrate the patterns of vegetation versus the patterns of built environment existent in the region. Land cover was also mapped for Chatham county, also focusing on contrasting existing vegetation to the existing built environment.

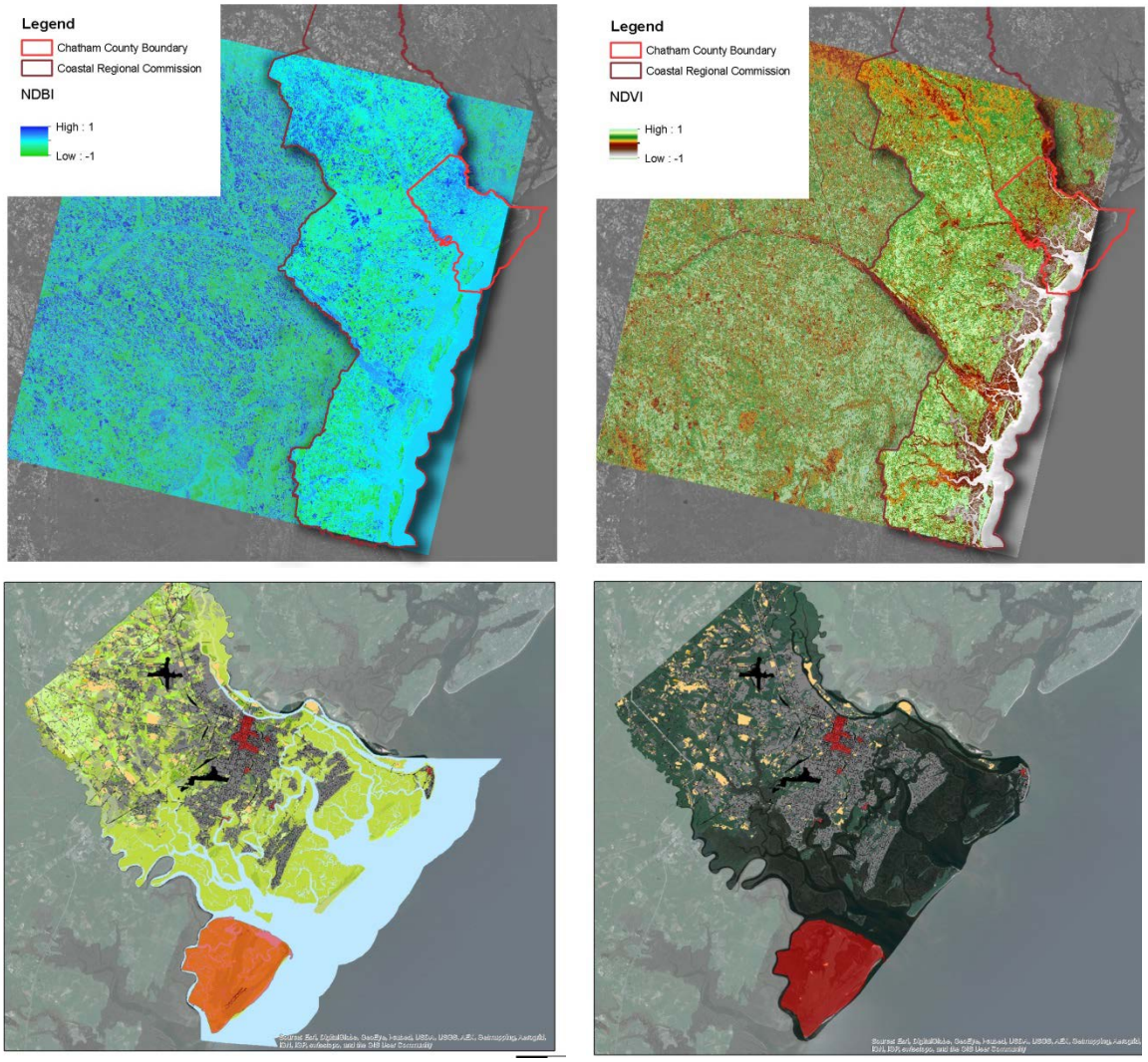


Figure 3 – Land cover analysis using Landsat 7 imagery and data acquired from Savannah Area GIS, for Chatham County.

All four maps generated demonstrate the existence of pockets of urbanization, surrounded by vegetated areas. Savannah is clearly identifiable as an urbanized area, especially in the maps focusing within the Chatham County boundaries. In the developed land map, several unoccupied and unvegetated areas appear, mostly in the outskirts of the urbanized cluster, indicating properties that could be sites for future development or where construction is underway.

Lastly, the regional analysis looked at the issue of flooding, mapping out storm surge categories and elevation specifically for Chatham County. Additionally, the storm surge map was overlaid onto the developed lands map, seeking to display how significant portion of the city is susceptible to flooding and what areas could be affected by severe weather events such as tropical storms and hurricanes.

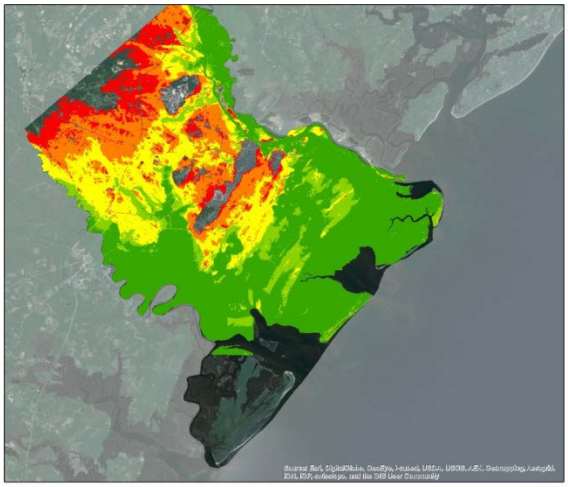


Figure 3 – Storm Surge Map demonstrating the areas affected by surges ranging from category 1 to 5.

Figure 4 – Elevation map.

Though it was quite clear that, like most coastal communities, Chatham County is very vulnerable to flooding, what becomes obvious from the resulting maps is the strategic positioning of Savannah's historic downtown. As mentioned previously in this document, the Oglethorpe Plan was carefully thought out and designed to ensure the safety of the city, leading to the implementation of the plat where it is today. The maps created aid in strengthening the argument that in the past there was a careful consideration for the characteristics of the natural environment and the establishment of settlements. It also demonstrates that that newer patterns of urbanization have

overlooked such issues and have allowed for the increase of impervious cover in areas at high risk for flooding.

City Scale

This phase of the analysis began by studying the growth patterns within the city of Savannah, aiming to comprehend the directions in which the city is expanding towards and how vegetation is being maintained as it expands. In order to do so, a map was created by overlaying building footprints from 1985 and 2012. Once this map was created, an additional layer was added, demonstrating existing tree canopy cover in 2012.

The results demonstrate not only how much Savannah has grown in 27 years, but also how it has become denser and is sprawling towards neighboring cities, such as Richmond Hills. The addition of tree canopy shows a higher density of trees within the historic district and in the outskirts of the city, point out that as the city grows it is losing significant amounts of tree cover.

In addition, to understanding growth patterns, this phase also focused on furthering knowledge on the local climate, seeking to understand the general climatic characteristics that could aid in the development of design guidelines specific to the city of Savannah. This portion of the analysis was done through graphs and tables that summarized the typical yearly climate performance.

The analysis started off by generating wind roses for summer and winter solstices, cross-referencing this data to relative humidity, temperature and rainfall, as well as determining the frequency of wind flows in each direction. With the understanding of

local directionality and speed of winds, one may begin to understand the changes terrain causes in ventilation, by comparing the graphs generated with the regional wind map. It is important to note, though, that the climatic data obtained is collected from the Savannah International Airport meteorological station, a vast area with no immediately surrounding building clusters. With that said, one should keep in mind the impacts the built environment causes to wind directions and speed, which are very likely to be less obvious in the obtained data.

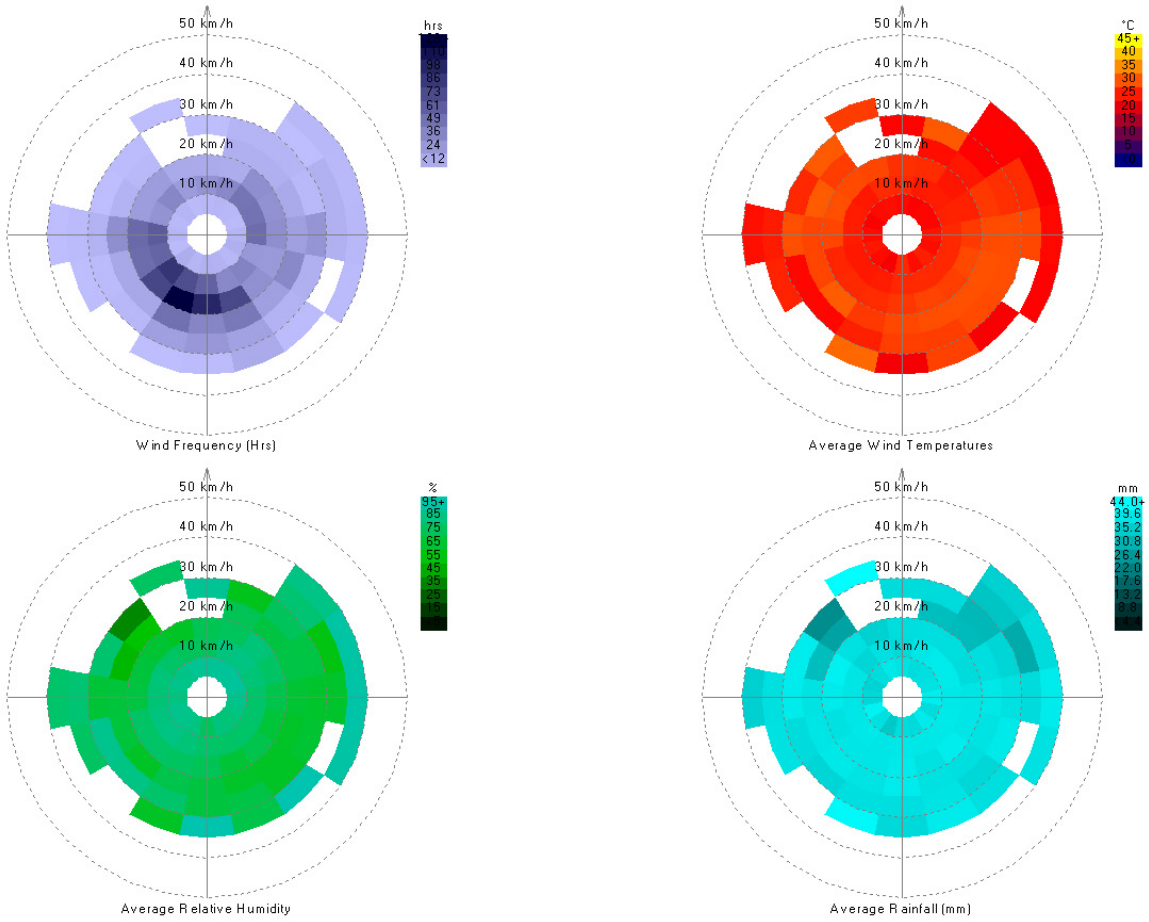


Figure 5 – Wind analysis summary for the city of Savannah – GA, during the Summer season (Ecotect, 2014)

According to the generated wind roses, during the Summer season winds flow more frequently from the south and southwest, at approximately 6.2 mph (10 km/h) in average, but reaching up to 24.85 mph (40 km/h). Wind temperatures vary between 86°F to 95° F (30°C to 35°C) in all directions, but southern winds are slightly warmer. Humidity tends to be over 75% and average rainfall is over 1.4 inches (35.2 mm), yet curiously winds flowing towards the northwest tend to be dryer, and consequently, carry less rainfall.

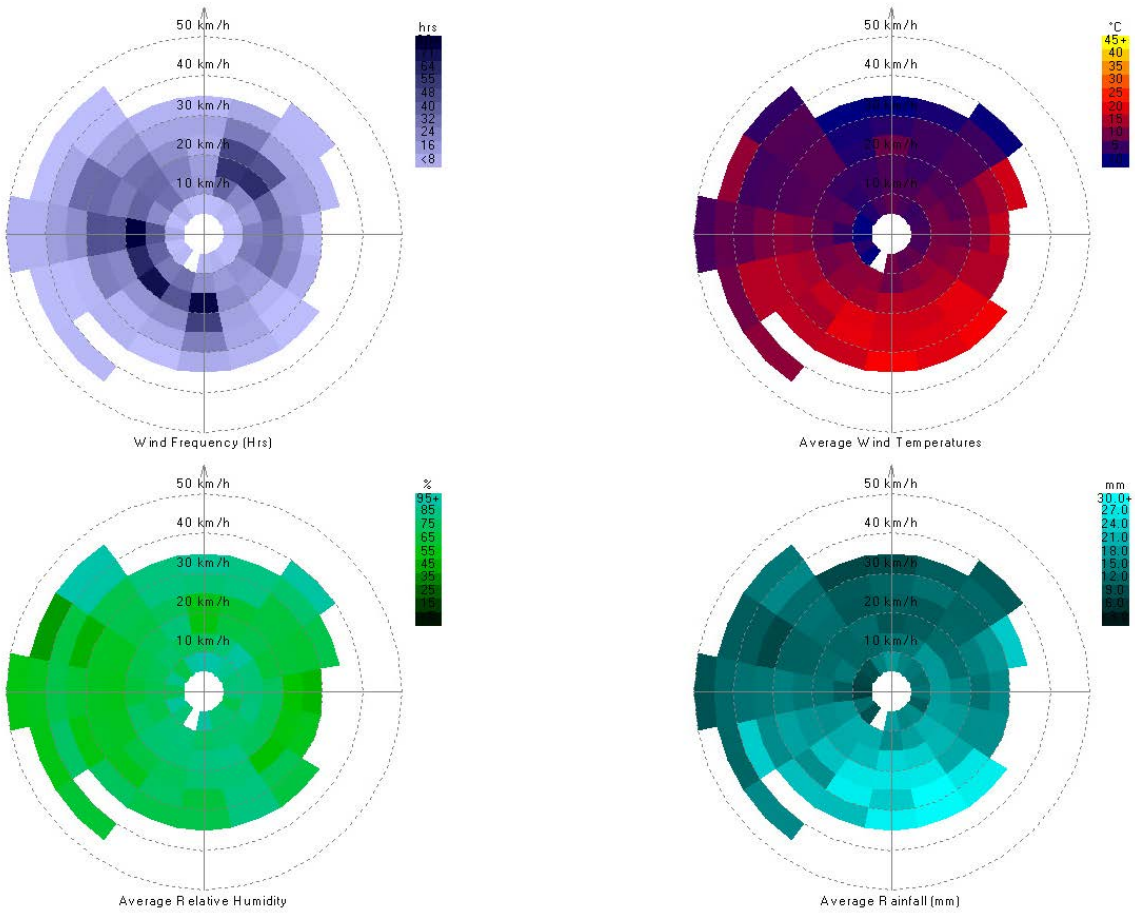


Figure 6 – Wind analysis summary for the city of Savannah – GA, during the Winter season (Ecotect, 2014)

Similar to the Summer season, during the Winter season winds flow more frequently from the south and southwest, yet there is also significant wind flow from the northeast as well, with speeds at 9.3 mph (10 km/h) reaching up to 31 mph (50 km/h). Wind temperatures vary most frequently between 50°F to 59° F (10°C to 15°C), but southern winds are slightly warmer. Humidity tends to be over 75%, but can reach as low as 55% and average rainfall is frequently lower than 0.7 inches (18 mm), while as previously seen winds flowing towards the north tend to be dryer, and consequently, carry less rainfall.

Using the same TMY3 data files used to generate the wind roses in Ecotect, the analysis went on to use Climate Consultant 5.5 to develop a psychrometric chart[6], that will display the amount of hours in a year in which a person will most likely feel comfortable. Additionally, the Climate Consultant 5.5 interprets the hours outside of the band of comfort introducing design strategies. Though these are intended to aid architects and engineers determine guidelines for indoor environments, the results obtained should be very similar to the strategies previously presented in the beginning of this chapter. The reason for expected similarity is due to the fact that it was Givoni who proposed the establishment of the sixteen strategies for building design guidelines widely used by architects and engineers, and used as reference by software, such as the Climate Consultant 5.5 and Ecotect.

[6] The Psychrometric Chart is a tool that presents the relationship between air temperature and humidity in graphical form, and helps describe the climate data and human thermal comfort conditions.

WEATHER DATA SUMMARY

LOCATION: **SAVANNAH, GA, USA**
Latitude/Longitude: 32.13° North, 81.2° West, **Time Zone from Greenwich** -5
Data Source: TMY2-03822 722070 WMO Station Number, **Elevation** 52 ft

MONTHLY MEANS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Global Horiz Radiation (Avg Hourly)	82	107	130	141	145	139	143	133	122	117	97	82	Btu/sq.ft
Direct Normal Radiation (Avg Hourly)	101	118	133	127	119	99	97	93	89	123	126	109	Btu/sq.ft
Diffuse Radiation (Avg Hourly)	37	44	49	56	61	66	69	68	63	46	38	36	Btu/sq.ft
Global Horiz Radiation (Max Hourly)	214	255	297	324	327	320	313	314	284	261	217	191	Btu/sq.ft
Direct Normal Radiation (Max Hourly)	303	314	318	309	300	274	263	263	262	302	303	309	Btu/sq.ft
Diffuse Radiation (Max Hourly)	104	116	147	161	170	162	158	174	155	132	105	98	Btu/sq.ft
Global Horiz Radiation (Avg Daily Total)	841	1159	1534	1814	1986	1968	1986	1759	1496	1309	1005	816	Btu/sq.ft
Direct Normal Radiation (Avg Daily Total)	1028	1284	1561	1622	1633	1395	1357	1226	1080	1378	1303	1084	Btu/sq.ft
Diffuse Radiation (Avg Daily Total)	383	482	592	724	834	939	963	901	780	524	394	359	Btu/sq.ft
Global Horiz Illumination (Avg Hourly)	2646	3403	4129	4538	4684	4577	4692	4382	3984	3722	3068	2592	footcandles
Direct Normal Illumination (Avg Hourly)	2730	3288	3712	3548	3299	2627	2522	2375	2325	3373	3386	2900	footcandles
Dry Bulb Temperature (Avg Monthly)	48	49	58	64	72	78	80	79	75	66	60	50	degrees F
Dew Point Temperature (Avg Monthly)	41	36	45	51	59	69	70	71	67	55	51	41	degrees F
Relative Humidity (Avg Monthly)	79	65	65	66	66	76	73	77	78	71	75	72	percent
Wind Direction (Monthly Mode)	250	30	180	230	210	200	210	150	40	50	50	180	degrees
Wind Speed (Avg Monthly)	9	9	9	8	7	7	7	6	6	6	8	8	mph
Ground Temperature (Avg Monthly of 3 Depths)	56	54	55	57	63	69	73	75	74	71	66	60	degrees F

Figure 7 – Summary of monthly weather data compiled by the Climate Consultant 5.5 software and used as a basis for the generation of a psychrometric chart for the city of Savannah, GA.

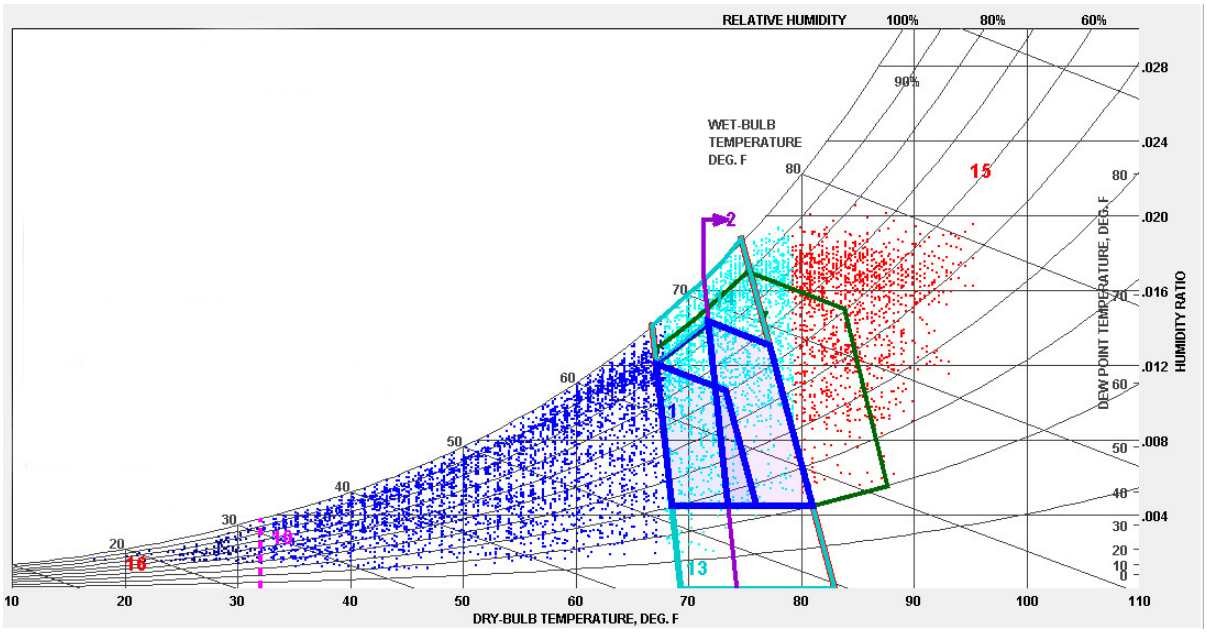


Figure 8- Psychrometric Chart for Savannah, GA.

DESIGN STRATEGIES: JANUARY through DECEMBER

12.4%	1 Comfort(1087 hrs)
17.9%	2 Sun Shading of Windows(1570 hrs)
	3 High Thermal Mass(0 hrs)
	4 High Thermal Mass Night Flushed(0 hrs)
	5 Direct Evaporative Cooling(0 hrs)
	6 Two-Stage Evaporative Cooling(0 hrs)
12.6%	7 Natural Ventilation Cooling(1104 hrs)
	8 Fan-Forced Ventilation Cooling(0 hrs)
	9 Internal Heat Gain(0 hrs)
8.3%	10 Passive Solar Direct Gain Low Mass(731 hrs)
	11 Passive Solar Direct Gain High Mass(0 hrs)
	12 Wind Protection of Outdoor Spaces(0 hrs)
0.3%	13 Humidification Only(22 hrs)
14.6%	14 Dehumidification Only(1280 hrs)
20.7%	15 Cooling, add Dehumidfication if needed(1809 hrs)
39.4%	16 Heating, add Humidification if needed(3454 hrs)

100.0% Comfortable Hours using Selected Strategies
(8760 out of 8760 hrs)

Figure 9 – Design Strategies derived from the psychrometric chart, in which the text is color coded in accordance to the graph, as a way of correlating strategies and climatic factors.

The results obtained from the psychrometric chart point out that only 12.4% of the hours of a year will tend to be perceived as comfortable by people in Savannah, all other hours will need to be improved upon, through the use of design strategies.

According to the simulated results, the introduction of shading and ventilation as design objectives for hot periods of the year could boost thermal comfort to approximately 43% of the hours in a year. Yet in an urban environment, unlike with designing a building, the designer is unable to use artificial means of cooling, heating and also dehumidification, which in this case account for the remaining hours of the year that are predicted to cause discomfort. Such discomforts may be reduced when the design is developed for specific sites, but in the city scale it is particularly difficult do establish guidelines that will guarantee comfort during all hours of the year.

Site Analysis

The last phase of the analysis process looked closer at two distinct sites in the city of Savannah to evaluate how the two different urban settings can respond to climate. Taking into account that strategies for a Hot-Humid climate are to allow for ventilation and shading, simulation program Autodesk Vasari was used to analyze both wind and solar radiation interactions. The intent of this phase is not only to visualize the differences between the urban patterns, but also to raise the discussion of how such knowledge could be used to change design choices and enable planners to develop future plans that can adapt to climate.

The first step of simulation was to analyze the performance of each site with regards to direct solar radiation. The evaluation sought to look at how density and proximity of buildings could impact solar radiation and how impervious and non-vegetated open areas in the urban network would perform without shading.

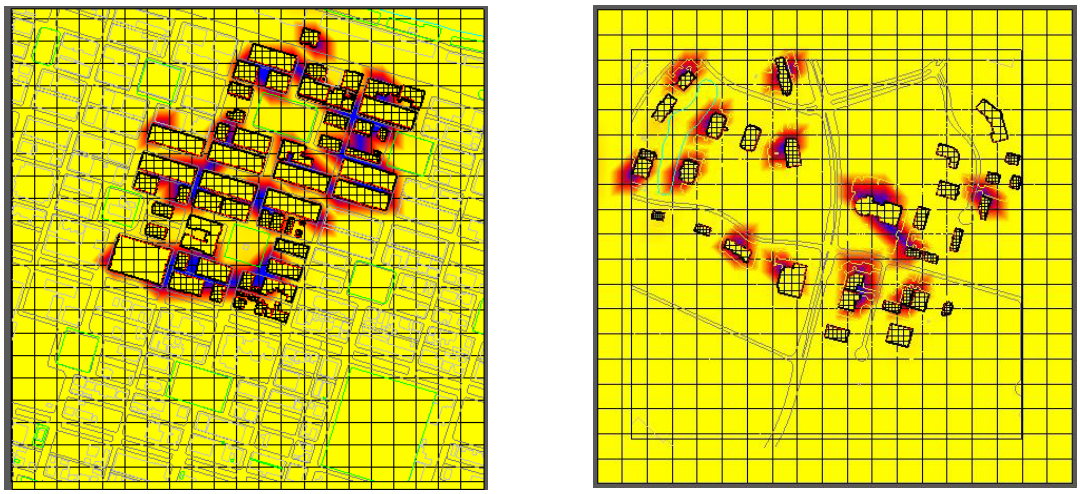


Figure 10 – Solar radiation analysis comparison between the two selected sites. (Vasari, 2014)

The results obtained were not surprising, and demonstrated a higher solar radiation emitance in areas considered to be non-shaded, but pointed out that areas in between buildings in the Historic Downtown tended to collect less direct solar radiation. What is important to point out, though, is that buildings could in fact reflect solar radiation, which in turn could lead to the formation of heat islands. Another important issue to reflect upon in this analysis is that vegetated areas, covered with trees, would in fact, react differently, and generate a blue coloration within the squares, which would drastically change the performance of radiation in this setting. The analysis on the second site, on the other hand, calls the attention to the potential increase in radiation due to additional impervious covers areas due to the existing parking lots.

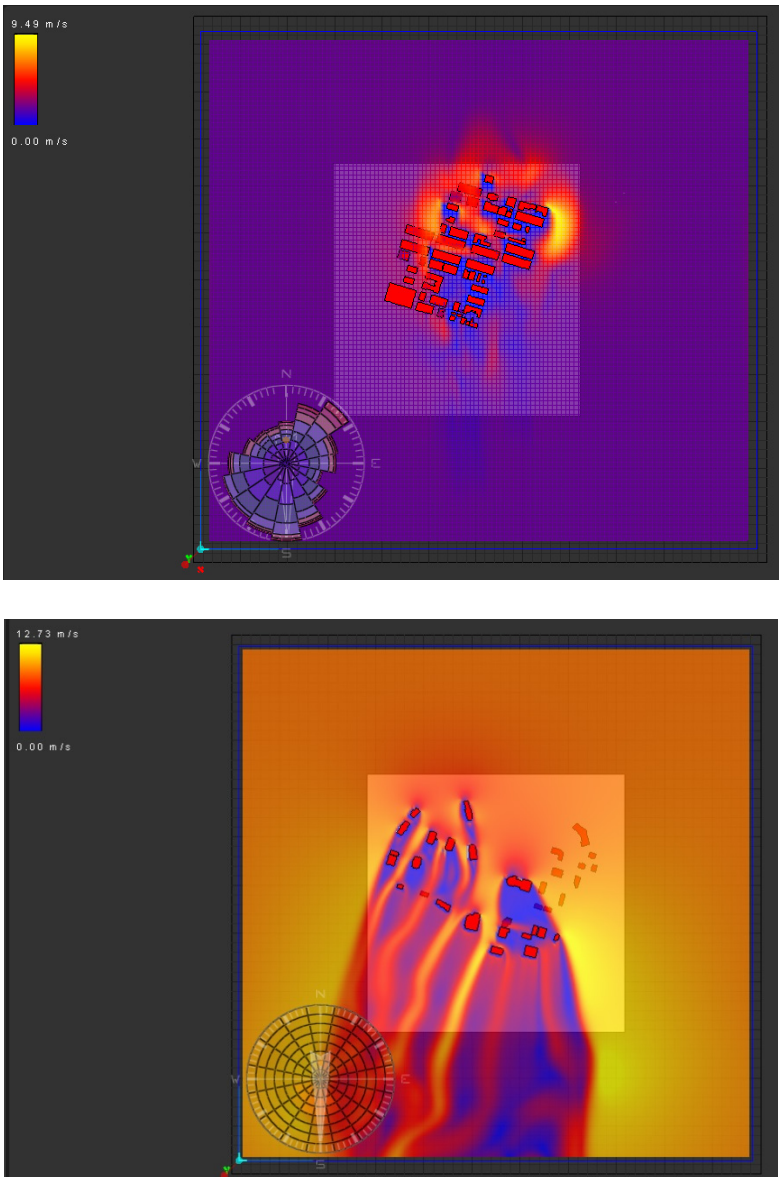


Figure 11 – Wind tunnel analysis simulated for both analyzed sites. (Vasari, 2014)

The wind flow analysis was also generated in Autodesk Vasari and takes into account the directionality and speed of wind. A wind tunnel simulation interface creates a 2D and 3D rendering of the wind patterns, displaying how the built environment change the direction and speed of air as it moves. In order to understand wind flow, one must acknowledge that as a fluid wind behaves similarly to water. Buildings function as pebbles in a stream, as water encounters a pebble it moves around it in order to return

to its natural course, creating small turbulences immediately after the pebble. Based on that analogy it becomes easier to understand the changes in speed and the dust like appearance that occur along the edges of the buildings, demonstrating slight shifts in directionality.

Results and Proposals

The overlay of information gathered from the three scales of analysis allow for a better understanding of the relationship between the built environment and climate. As a starting point the regional scale served as an introduction to the physical characteristics of the area. Most importantly, the use of land cover data allowed for the comprehension of the extent of urbanization within the region and the composition of vegetated cover that encompasses the built environment. From the design perspective, however, this scale is much too broad and does not allow for further understand of how vegetation is in fact distributed and incorporated to the built environment.

In the city scale, unlike the regional scale, designing with climate becomes a possibility. It allows for a closer look at street networks, which combined with the understanding how wind patterns, can allow for the stipulation of how air can be conducted within the city. Additionally, evaluating the effects of building heights and the existence of gaps between street blocks can also aid in the creation of designs that preserve the natural air flow. From the shading perspective, the city scale can be very effective in documenting existing tree canopy cover and its distribution within the city

network, which may lead to the identification of potential areas for the implementation of urban forests, neighborhood parks and greening along streets. The use of tree canopy cover as a design mechanism could also aid in the reduction of the effects of radiation. The creation of tree covered open spaces will form pockets in the urban network, this in turn could enable wind flows to pick up speed and diminish turbulence.

The choice of conducting site specific analysis envisioned the depiction of representative typologies of urban patterns in Savannah, seeking to better illustrate the differences in the performances of two different design approaches. On the one hand a densely built environment permeated by tree covered squares, and on the other a sprawling area with buildings sparsely distributed and a significant area of impervious cover composed both by buildings and surface parking lots.

As a pilot for the presented analytic approach, the study of Savannah leads to the relevance of tree canopy cover as a tool for successfully adapting to climate and ultimately establishing resilient communities. Such conclusion, though, is only made possible after careful evaluation of all three scales of analysis, but brought to light through the analysis of the existing urban typology.

In the presented sprawling typology, radiation is the main cause of concern, due to the large concentration of impervious surfaces created from the combination of buildings and surface parking lot. The insertion of trees as shading mechanisms could reduce the effects of radiation, as well as controlling stormwater run-off. Unlike the downtown typology, where density becomes an issue, in areas similar to this wind

directionality and speed suffer less impacts, as buildings are spread farther apart. In denser areas, such as the downtown, wind patterns suffer more changes and turbulence occurs frequently. This is where Savannah is unique, for the typology presented by its historic downtown incorporates tree cover in its design, demonstrating the benefits of using trees as mechanism for climate adaptation. The question that rises from the studied examples is what can be done in denser urbanized areas, where there are no trees and there is little space for their incorporation.

Furthermore, in order to adequately use tree canopy cover as adaptation mechanism a metrics must first be created, which in turn could be set as a performance standard to aid planners in both evaluating and designing adaptation plans. Currently cities quantify tree canopy strictly by establishing the percentage of cover, yet with climatic design the use of tree canopy cover is directly correlated to the distribution of coverage inside the urban network. Therefore, the correlation of the percentage of coverage must be associated to a measurement of area, in other words, design guidelines should establish a percentage of tree cover per square foot, to be attained as a reference to adequately designing with climate. However, in the neighborhood scale or site specific scale, such metrics will then have to be correlated to the percentage of existing impervious cover, shading and reflectance, seeking to ensure that sites will not constrain tree covered areas to surround the built environment, as opposed to incorporating trees in the urban design.

Though, stormwater has not been the focus of the research, it is important to point out the relevance that the increase in tree cover has in reducing run-off and directly responding to the issue of flooding. With that said, it is also important to point out that Stormwater Management Utilities do not utilize the increase of tree canopy cover as a strategy for reducing flood impacts. The incorporation this strategy could serve as a boost for adaptation and aid cities in effectively becoming resilient to climate both from the thermal and flooding perspectives.

This study also demonstrates how sprawling areas have a considerable advantage to adapting as opposed to densely established urban areas. This afirmation, however, is not intended to state that it is advantageous for sprawl to occur in the first place, yet it points out the possibility of reconfiguration with adequate incorporation of climate as a tool. In this urban conformation buildings tend to be scattered allowing for adequate permeation. To adapt these areas the use of tree canopy cover should be allied to the stipulation of setbacks and spacing between buildings, oriented in such a way that can secure natural wind flow within the urban network even as infill occurs and density increases.

Lastly, while using thermal comfort as a guiding factor to the establishment of design strategies, this study points out to the potential of better involving and educating not only planners, but also the general public on issues such as heat island effect. The fact of the matter is that the discussion of climate change has overwhelmed the general public and establishing a connection that demonstrates effectively how climate is changed by urbanization is a challenge. The discussion of flooding has begun a

process of perception that could go even further by seeking to convey to the public the issue of thermal perception. Analyzing human comfort levels could serve both as an educating mechanism, asking the public to reflect on how hot or cold they feel in certain areas, but could also serve as metrics for establishing performance standards that aim to promote comfortable outdoor spaces. Such metrics would also go hand in hand with the promotion of walkable environments and healthy communities and can be directly correlated to programs promoted by agencies such as the Agency for the Aging, under the administration of the Georgia Regional Commission, seeking to promote a healthy environment and protecting the more vulnerable from possible climate stressors.

CHAPTER 6

DISCUSSIONS

"I started looking to ways human beings imitate nature. And so one of the things I studied at the time was the idea of the prosthetic device. (…) And what occurred to me is that the prosthetic device has to integrate with a host, an organic host body, which is the human body. It then occurred to me that in a similar way to that everything that we build, equivalent to prosthetic devices and our host organism for our built environment is the earth, is the biosphere. And the successful integration is the eventual success of the earth, and the green future." (Ken Yeang, 2006)

It is difficult to approach the issue of incorporating climate adaptation to planning and urban design without challenging planners to dive deeper into the subject, and expecting a much profound and more technical knowledge of the issues at hand. Yet in many ways planners have been delaying having to deal with such issues and for the most part have not truly committed themselves to the understanding of how urban design and future land use plans can be affecting climate. Most of the discussion of climate change, and climate mitigation, until recently, did not involve planners, and while the effects of urbanization are a clear cause to much of the climatic changes we have seen, the truth of the matter is that planners have not yet stepped up to the plate.

Initiatives in the urban sphere have come from architects, landscape architects and engineers, who inspired by the concepts and rating systems such as LEED, have been seeking to produce green buildings and sites that are less impacting to the natural environment. Such a trend has brought about an understanding of the natural environment, focusing on reducing impacts to the natural water cycle and the incidence of heat island effects. While these actions have great merit in reducing the impacts to climate, they are very small when compared to what could be done in a city or regional scale, which is inevitably the planning realm. Additionally, cities planned to adapt to climate can give an even greater opportunity for the design of sites that are better adapted to climate. Buildings and sites are currently planned through simulations that rarely take into account their surroundings, and rely on unrealistic climatic data, collected in airports and areas with little to no building density surrounding it. In other words, many green buildings could be performing better if only the city was responding to climate as well. Planning with climate could give sites an even better start and policies can push for a more effective approach to reducing impacts.

Coastal communities, have been the first to realize the effects of urbanization and have begun to perceive the importance of acknowledging the need for adaptation. The eminent danger of flooding along with major changes to the National Flood Insurance, have brought an urgency to planning for resiliency and making sure cities can reduce risks when faced with extreme weather events. Yet as planners, much of our focus has been solely on water, and the importance of protecting flood plains,

ignoring the fact that this is only a small part of the climate discussion. There is a unique opportunity at hand for planners to use urban design as a tool for adaptation, to adequately respond to more than flood management. Questions such as: "What factors are collaborating to social vulnerabilities?" or "How comfortable people feel in urban environments?", need to be asked and addressed. Moreover, there is a clear juxtaposition between planning for flooding and planning for climate, since flooding is a result of climatic interactions, planners need only broaden the scope of analysis. Such juxtaposition can also be seen between planning for social equality and climate, the incorporation in this case can occur in seeking to create more comfortable and healthy environments, that promote the reduction of vulnerability for certain social groups.

From the planning perspective the establishment of healthy communities has been intertwined to the concept of promoting walkability. In order to achieve such a goal, people need to feel comfortable outside. In this sense, climate can be a useful tool in order to ensure a healthy urban environment, which promotes a condition that enables people to engage in outdoors activities during a higher percentage of hours during the year.

Though the importance of adapting cities to climate and reducing the impacts of urbanization has been established, planners must find a practical approach to dealing with the subject and making sure cities can continue developing while seeking adaptation. In the case of Savannah, and all of the coastal communities in Georgia, there is a unique opportunity to incorporate issues of climate to the established

Coastal Regional Commission's rating system, currently under revision in order to incorporate flood management strategies as a way of responding to the recent changes in the National Flooding Insurance. This assessment tool has potential for becoming a strong form of implementing a practical approach to climate planning. It can combine climatic issues under not only flood management, but also through the evaluation of quality of life, and reducing vulnerabilities to an already established aging population.

This project leaves the opportunity for furthering studies on how incentives can be created to incorporate climate planning. Studies must be developed to understand how plans can be evaluated and furthermore rated, as a way of stimulating long term plans that aim at reducing the major effects of urbanization. Additionally, there must be an establishment of the types of tools and information that must be made available to planners in order to both educate and enable them to effectively plan with climate.

Fortunately, there have been many advances in research in this field, and much can be learned from other professions on how to design with climate. Planning is inherently a multi-disciplinary field, and planners have always been faced with the challenge of learning a little bit of "everything" as a result of attempting to grasp the many issues involving the urban sphere and the natural environment. To take on the challenge of climate is to acknowledge that humans have drastically changes landcover and adapting is insuring that we do not continue making the same mistakes.

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Sustainable Communities Plan for Coastal Georgia

Environmental Planning Studio

College of Environment + Design

UGA

Spring 2014

Part One.

Survey of Existing Conditions

March 2014

Prepared for:

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SITE VISITS & INTERVIEWS

Over a period of three days, February 6–8, 2014, the planning studio visited the five-county study area in Coastal Georgia, and the team met with planning agency staff and other county and municipal officers to gain first-hand insight into the conditions, issues, and opportunities there. The following list outlines the meeting schedule across the study area:

Coastal Regional Commission
Lupita McClenning, Director of Planning and Government Services

Coastal Georgia Historical Society
Mimi Rogers, Curator

Bryan County
Ray Pitman, County Administrator

Camden County
John Peterson, Director of Planning and Development

Glynn County
William M. Weeks, City Manager, City of Brunswick
Arnie Glaeser, Planning and Development Manager, City of Brunswick
Mathew Hill, Executive Director, Brunswick Downtown Development Authority

Liberty County
Jeff Ricketson, AICP, Executive Director, Liberty Consolidated Planning Commission
Joey Brown, County Administrator
Billy Edwards, City Manager, City of Hinesville

McIntosh County
Brett Cook, County Manager
Wally Orrel, Executive Director, Industrial Development Authority

DEFINITION OF STUDY AREA
(Prepared by: Jimmy Adams)

The study area consists of a portion of the 10-county CRC Region. The five counties that establish the study area include Bryan, Camden, Glynn, Liberty, and McIntosh counties. These counties combine for a total area of approximately 2,999 square miles and are illustrated on Map 1. A more detailed review of the study area reveals that the land area within the five-county region is approximately 2,446 square miles and water bodies cover approximately 553 square miles. Bryan County is the only county in the study area that does not have direct coastal access and also does not have any barrier islands. The City of Savannah, in Chatham County, is located approximately 12 miles north of the identified study area boundary, and the City of Jacksonville, Florida, is located approximately 27 miles south of the study area boundary.

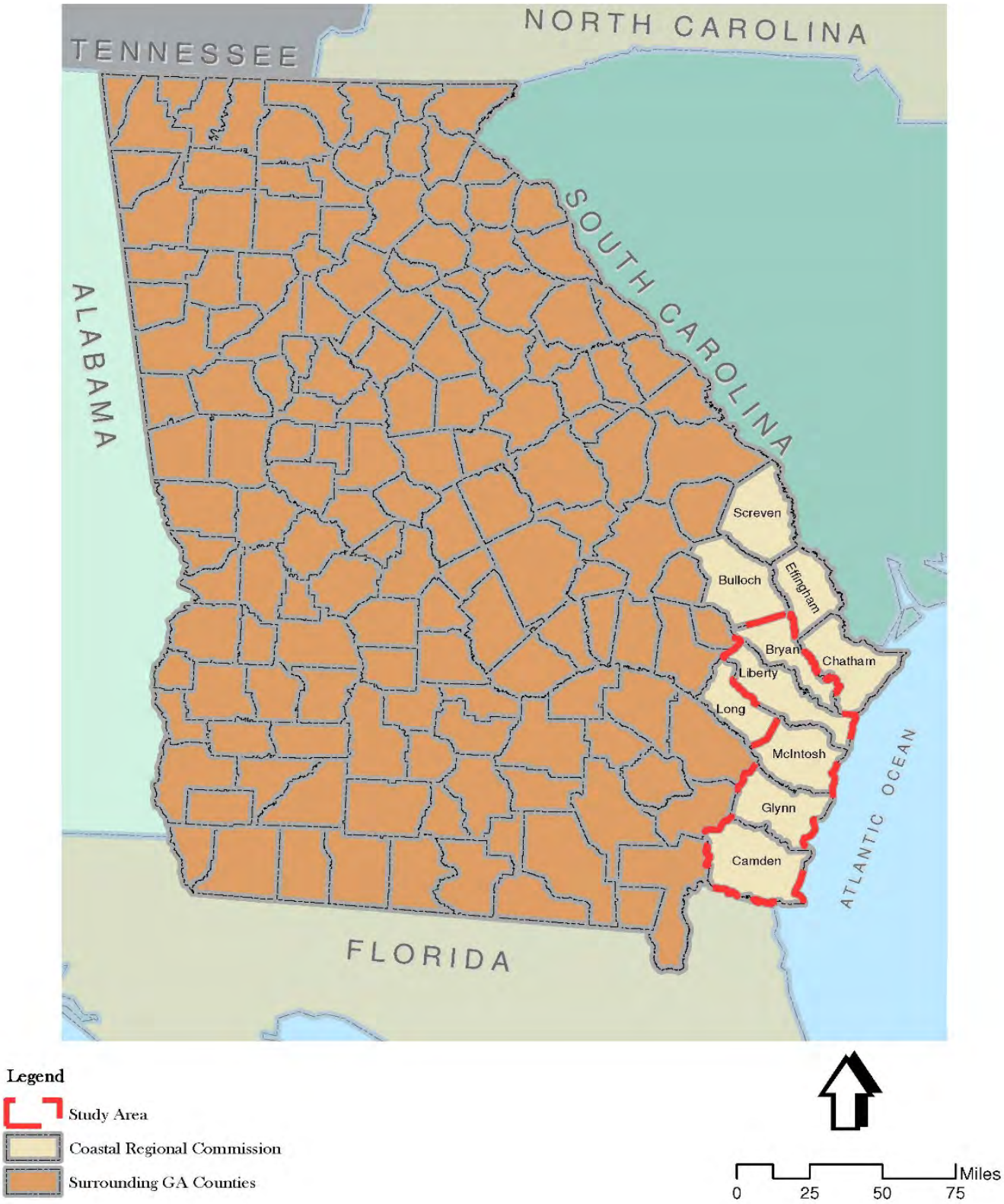
The region being examined is characterized primarily by low-density development, scattered along the east coast of Georgia. There are 14 cities within the study area that provide more urban opportunities; however, the remaining unincorporated portions of the study area are largely rural in character. Two military bases provide the region with employment opportunities and significantly affect the demographic characteristics of the study area. The bases also necessitate additional residential development, particularly for those who desire to reside off of the base. The study area's municipalities and military bases are illustrated on Map 2, and a snapshot of the study area data is provided in Table 1.

Table 1: Study Area Summary Data

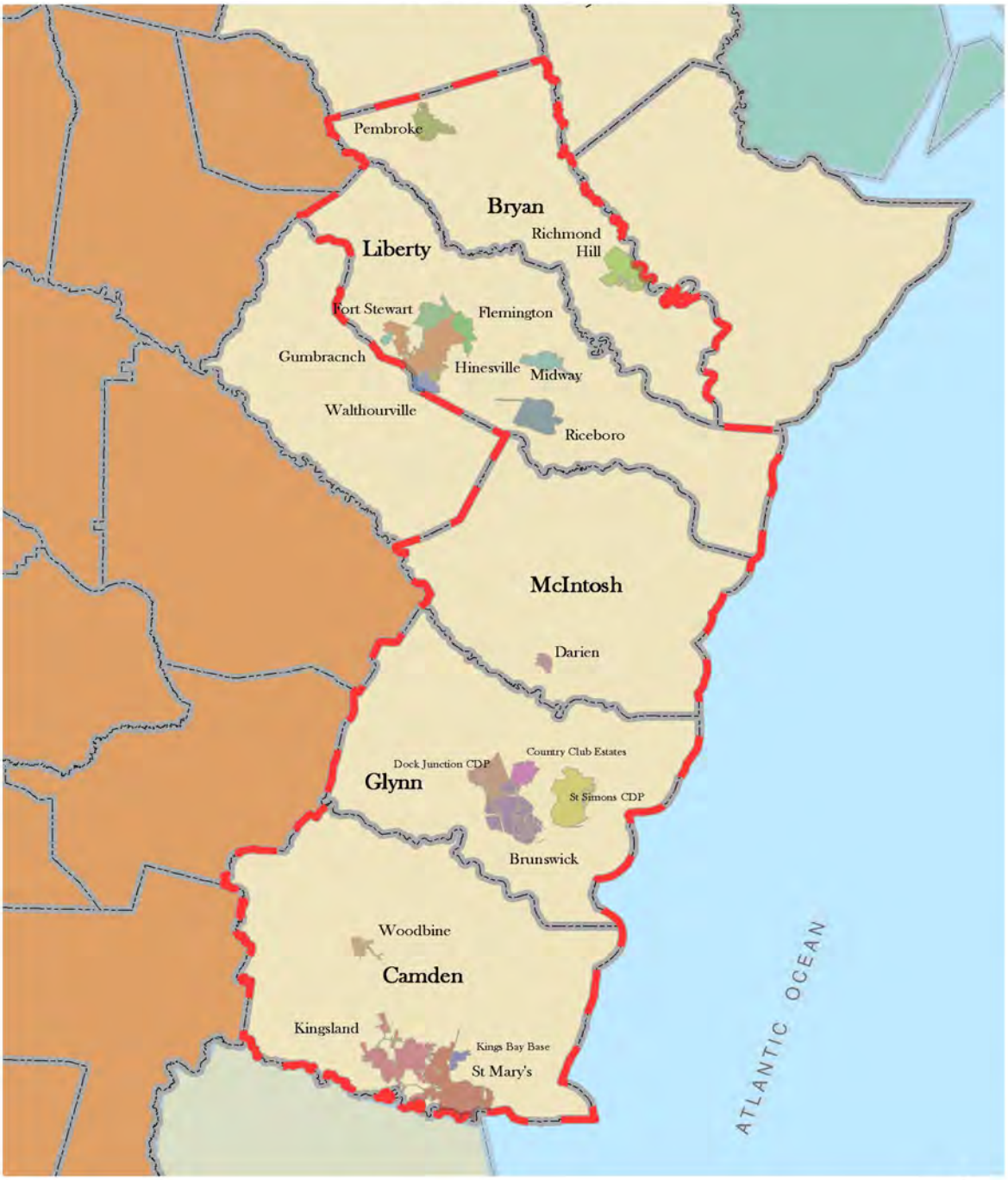
County	Area (sq. miles)	Land (sq. miles)	Water (sq. miles)	2000 Population	2012 Estimated Population	Annual % Growth	County Seat
Bryan	454.49	441.71	12.78	23,417	32,214	2.6%	Pembroke
Camden	782.52	629.91	152.61	43,664	51,402	1.5%	Woodbine
Glynn	585.17	422.37	162.80	67,568	81,022	1.7%	Brunswick
Liberty	602.52	519.05	83.47	61,610	65,471	0.3%	Hinesville
McIntosh	574.53	433.45	141.08	10,847	13,839	2.8%	Darien
Total:	**2,999.23**	**2,446.49**	**552.74**	**207,106**	**243,948**	**1.8%**	

Source: U.S. Census Bureau: State and County QuickFacts.

Map 1: Project Vicinity



Map 2: Municipalities



Legend

Study Area

Miles

0 5 10 15

HISTORICAL BACKGROUND

Formative Landscape Events
(Prepared by: Kelly Howard)

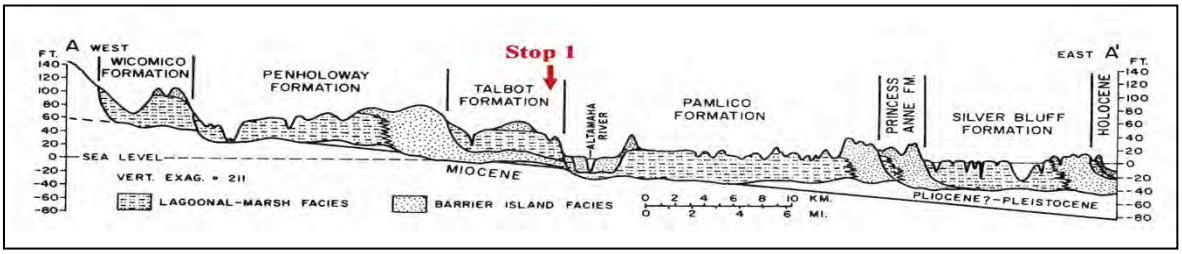
Fall line separating Coastal Plain from Piedmont Plateau.

Georgia's coast is in the physiographic region known as the Coastal Plain province. Although the youngest of Georgia's provinces, the Coastal Plain occupies more than half of the state's land surface (Henry, 2013). The formation of the Coastal Plain—with its bluffs, marshes, and barrier islands—is a result of the convergence of natural forces.

Sixty million years ago, much of Georgia was underwater, and its shoreline was much farther inland. Towards the end of the Cretaceous Era, 65 to 70 million years ago, a global rise in sea level marked Georgia's oldest shoreline at the present-day Fall Line that spans middle Georgia from Columbus to Macon to Augusta (Lenz, 2002). The Fall Line separates the Coastal Plain province from the Piedmont Plateau province to its north. Sediments such as clays and sands were carried down from the Blue Ridge and Piedmont Plateau provinces and deposited at the Fall Line, forming the original shoreline (Johnson et al., 1974). Millions of years of subsequent Piedmont surface erosion provided additional sediment to the Cretaceous shoreline until the Coastal Plain built out and up to its present extent (Henry, 2013).

During the Cenozoic Era, 63 million years ago, Ice Age glaciations produced a 400-foot drop in sea level, placing Georgia's shoreline 95 miles east of its current position. The receding sea deposited sediments that formed the Lower Coastal Plain. The Lower Coastal Plain's physiographic region begins at the present-day shoreline and runs inland for 60 miles. During the Pleistocene Epoch that began 2 million years ago, the repeated freezing and thawing of the polar ice caps raised and lowered sea levels, which formed successive shorelines that appear as a series of inland sand ridges today.

Where the Atlantic meets the Lower Coastal Plain of Georgia, there are shorelines (or terraces) and offshore islands known as the Barrier Island Sequence (Seabrook, 2006a). These islands form a shoreline complex of two ages, one being an older shoreline formed during the Pleistocene epoch and a newer shoreline formed during the current Holocene epoch. At present, the coastal mainland is made up of two of these former barrier island/back-barrier shorelines: the Pamlico shoreline complex and the Princess Anne. A former Pleistocene shoreline, known as the Silver Bluff formation, makes up part of the present-day barrier island complexes (Thomas et al., 2013).



Cross-section of Pleistocene and Holocene sediments of Coastal Georgia (Johnson et al., 1974).

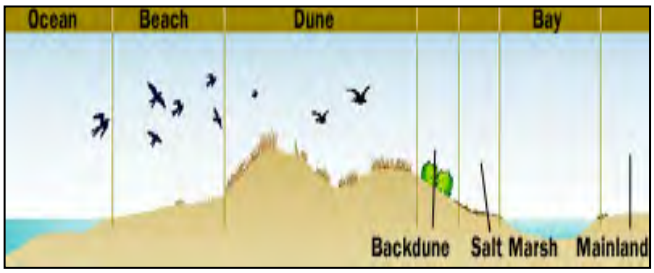
The older and innermost set of islands was formed during the Pleistocene epoch 35,000 to 40,000 years ago before the last great ice age. These islands include St. Simons, Sapelo, and Skidaway. The

newer and outermost set of islands was formed during the Holocene epoch 4,000 to 5,000 years ago. These islands include Blackbeard, Little St. Simons, Ossabaw, Sea Island, Tybee, and Wassaw (Johnson et al., 1974). Composed of dune and beach-ridge sands, the barrier islands were shaped—and continue to be shaped—by wind, waves, currents, tides, and gradual sea level rise (Seabrook, 2006a).

Barrier islands of Georgia.

Marsh islands within the back-barrier area are believed to be relics of former shorelines formed 18,000 years ago during the Pleistocene epoch (Seabrook, 2006b). Ice age glaciation that formed these primordial shorelines were later followed by glacial melting and sea level rise, which caused water to pool (in the form of lagoons) behind the primordial shorelines (Johnson et al., 1974). Marsh formation most likely occurred sometime after the Princess Anne shoreline but before the Silver Bluff shoreline. It is also possible that they were parts of the Princess Anne and/or Silver Bluff shorelines that have since been separated by erosion from these larger features (Thomas et al., 2013). The perfect conditions of barrier islands to the east and rivers to the west have resulted in the large expanse of marshes that covers the Lower Coastal Plain.

Georgia's coast is unique in that the older set of barrier islands have not become integrated into the mainland. The gradual slope of the Coastal Plain and continental shelf, coupled with the high tidal range of 6 to 9 feet, creates the rare condition of tidal water completely surrounding both the older and newer sets of barrier islands (Johnson et al., 1974).



Transect of coastal features.

English Settlement and Military Conflict
(Prepared by: James Bradley)

When you examine the initial settlement in many regions in America, you can usually follow the money. People will migrate to an area for economic opportunity or an abundance of natural resources that can be sustained for survival or a perceived overall better quality of life. Coastal

Georgia is not one of these places. Established by James E. Oglethorpe, Georgia's first governor, in 1732 as a colony to handle ex-convicts that would otherwise be recycled to the streets of London, the Georgia Colony became strategically important militarily (Gannett, 1905). It was the land between South Carolina and Spanish-controlled Florida.

James E. Oglethorpe established the colony of Georgia in 1732.

Upon arrival to the new colony, early English settlers made land agreements with the native peoples of the Creek tribe (Blaney, n.d.). The Creek eldership and Oglethorpe exchanged generous gifts and made land agreements (Blaney, n.d.). Although some of the Creek tribe members resented the settlers, the relations between the two groups were generally good. Though not well documented, the efforts of Christian missionaries in 1566 through 1680 are likely partially responsible for this positive relationship (Blaney, n.d.). This is positivity reflected in the anglicized names of many of the area's islands, such as Jekyll Island.

Oglethorpe's regiment established Fort Frederica around 1736 to provide a defense against an attack from the Spanish in Florida (Cashin, 2013). In 1742, the Spanish unsuccessfully attacked the fortress in the Battle of Bloody Marsh (Cashin, 2013). Oglethorpe's regiment eventually left the fort after the invasion attempt, opening the door to other countries laying claim to it. This military exit and unstable provincial ownership contributed to the low population density of the area.

Model of Ft. Frederica, St. Simon's Island, GA, circa 1736.

During the American Revolutionary War, British forces faced a stalemate with the northern colonies, so they decided to try a new strategy in the south. In 1778, they victoriously led a siege in

Savannah and overwhelmed General Robert Howe's defenders (Clark, 1980). They occupied the city until 1782. This occupation served as the southern flank of the British forces until the end of the war (Cashin, 2013).

The coastal lands of Georgia were affected by war again in 1864 during the American Civil War, when Union Army General William T. Sherman led a march to the sea. He burned everything in his path, reaping devastating destruction. As part of Sherman's campaign, the Union Army took Fort McAlister and used it to house prisoners during the conflict. The earthwork fortress, which was designed primarily to defend Savannah from naval attacks, was easily overwhelmed by Sherman's ground attack (Miles, 2002).

The region continues to host military forces today, including Fort Stewart, Kings Bay Submarine Base, and Hunter Army Airfield.

DEMOGRAPHICS
(Prepared by: Jimmy Adams)

Population growth patterns, household characteristics, employment patterns, and business concentrations are key factors in gauging the strengths and current conditions of the study area. This section discusses the following conditions and provides key demographic data for the five-county region being examined:

- Population and Household Growth
    - Household Characteristics
    - Household Income
- Housing
- Employment Patterns
    - Businesses by Industry
    - Employment by Industry

Population and Household Growth

In 2012, an estimated 243,948 residents were living in the study area. Based on 2000–2010 annual growth rates for each county, the 2014 population is projected to be 250,952 residents. The 2007 Georgia Coastal Comprehensive Plan Assessment further indicates that the region will grow approximately 11% by the year 2020 and an additional 8% by 2030. Using the 11% and 8% growth patterns, respectively, for the years 2024 and 2034, Table 2 shows that the population of the study area is projected to be 300,841 by 2034.

Table 2: Population Projections

County	Year 2000 Population	Year 2010 Population	Annual Growth Rate (2000 to 2010)	Estimated Year 2012 Population	Projected Year 2014 Population	Projected Year 2034 Population
Bryan	23,417	30,233	2.59	32,214	34,322	-
Camden	43,664	50,513	1.47	51,402	52,311	-
Glynn	67,568	79,626	1.66	81,022	82,438	-
Liberty	61,610	63,453	0.30	65,471	67,556	-
McIntosh	10,847	14,333	2.83%	13,839	14,325	-
Region Total:	**207,106**	**238,158**	**-**	**243,948**	**250,952**	**300,841**

Source: U.S. Census Bureau: State and County QuickFacts.

According to the 2000 Census, there were 73,587 households in the study area, which increased to 88,685 by the year 2010, an average projected growth rate of 2.29% in the number of households. The rate of growth for households is somewhat consistent with the population growth rate, indicating that average household size has not varied over the 10-year period. The number of households and accompanying growth rates for each of the five counties within the study area are summarized in Table 3.

Table 3: Households from the Years 2000 to 2010

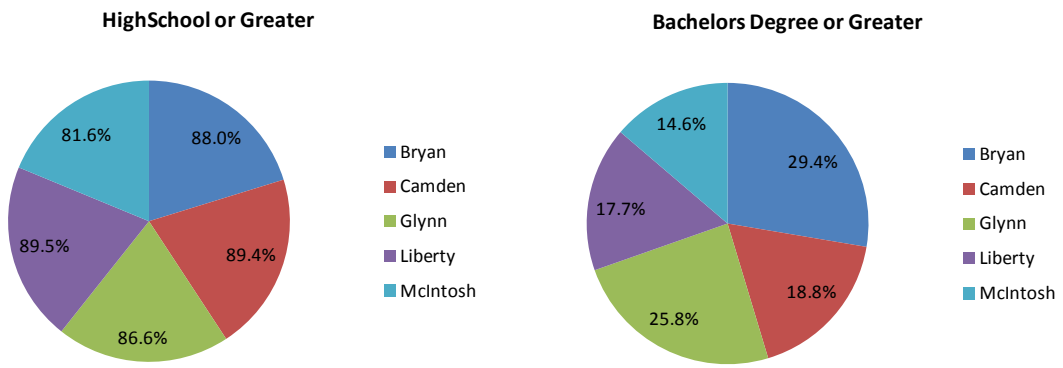
County	Year 2000 Households	Year 2010 Households	Annual Growth Rate (2000 to 2010)
Bryan	8,089	10,738	2.87%
Camden	14,705	18,047	2.07%
Glynn	27,208	31,774	1.56%
Liberty	19,383	22,155	1.35%
McIntosh	4,202	5,971	3.58%
Region Total:	**73,587**	**88,685**	**2.29%**

Source: U.S. Census Bureau

Household Characteristics

The average household in the five-county study area has 2.69 people, which is consistent with the 2.70 people per household across the State of Georgia. In terms of educational attainment for residents over the age of 25 within the five-county region, the largest proportion (87%) has some college experience or an associate's degree. This is slightly higher than the corresponding figure for the State of Georgia (84.4%). The percentage of residents who have attained a bachelor's degree or higher (21.3%) is slightly lower than for the State of Georgia (27.8%). Graph 1 shows the educational attainment for each of the five counties.

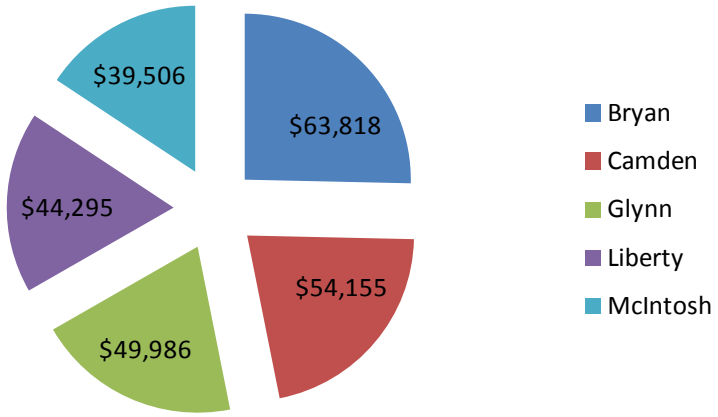
Graph 1: Educational Attainment



Source: U.S. Census Bureau: State and County QuickFacts.

The average household income for the five-county study area is $50,352, which is slightly higher than that of the State of Georgia ($49,604). Each county's average household income differs, as illustrated in Graph 2.

Graph 2: Median Household Income, 2008–2012



Source: U.S. Census Bureau, 2008–2012

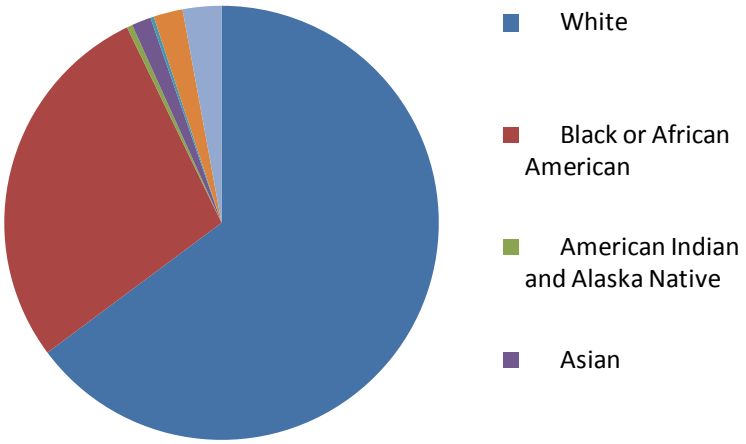
Household Units

Based on U.S. Census data for the year 2010 and Census estimates for the year 2012, the five-county region appears to have added additional housing units. For the year 2010, there were 109,623 housing units within the study area. This total is estimated to have increased by 1,545 housing units in the year 2012, for a total of 111,168 housing units. This increase in housing units for the five-county region results in an approximate annual growth rate of 0.01%.

Race Characteristics

The U. S. Census data estimates for the year 2010 indicate that the study area is predominately "white." There are 154,326 persons classified as white from a total population of 238,158 persons within the study area. Only 598 people were classified as "Native Hawaiian or other," the category with the fewest residents. Graph 3 illustrates the race characteristics within the study area.

Graph 3: Race Characteristics



Source: U.S. Census Bureau: State and County QuickFacts.

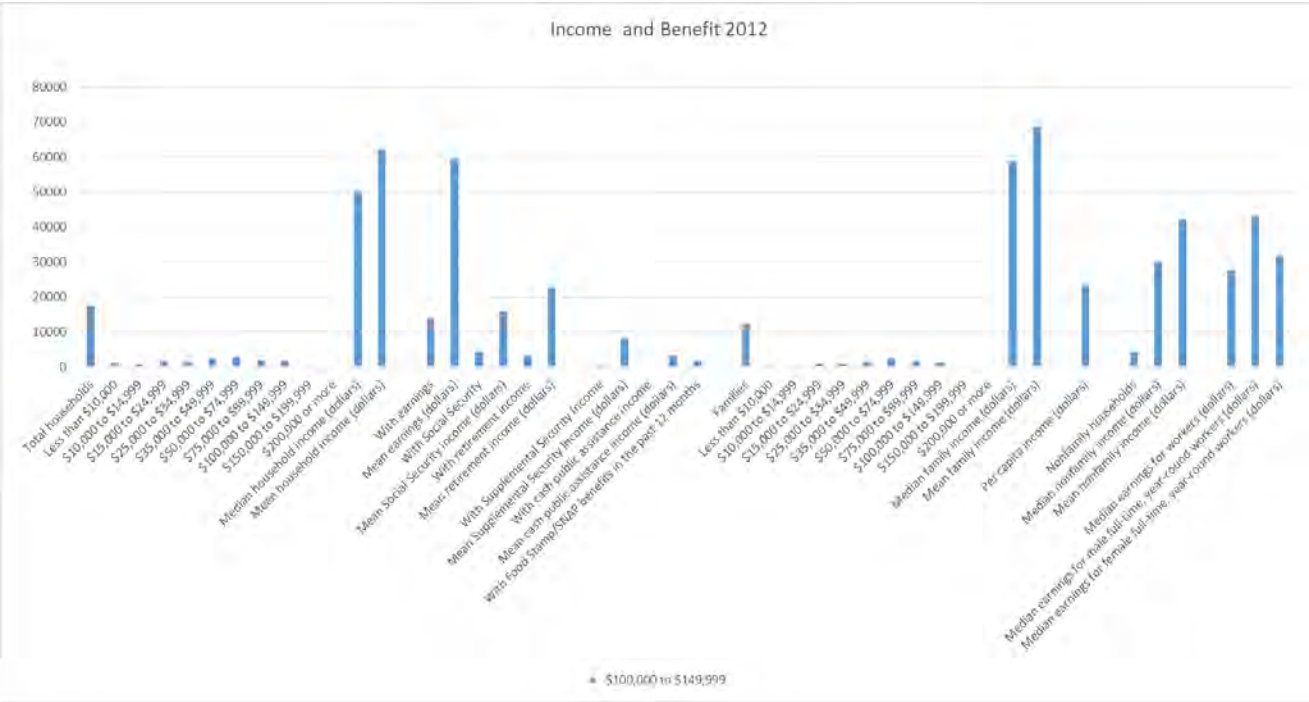
ECONOMIC PROFILE
(Prepared by: Jelani Linder)

To understand the issues and opportunities that exist in the study area, data on economic indicators were gathered. This section presents the following conditions and demographic data representing the five-county region being examined:

- Income and benefits

- Employment Status
- Class of workers
- Number of business establishments
- Work commute

Graph 4: Income and Benefits 2012



Income and Benefits

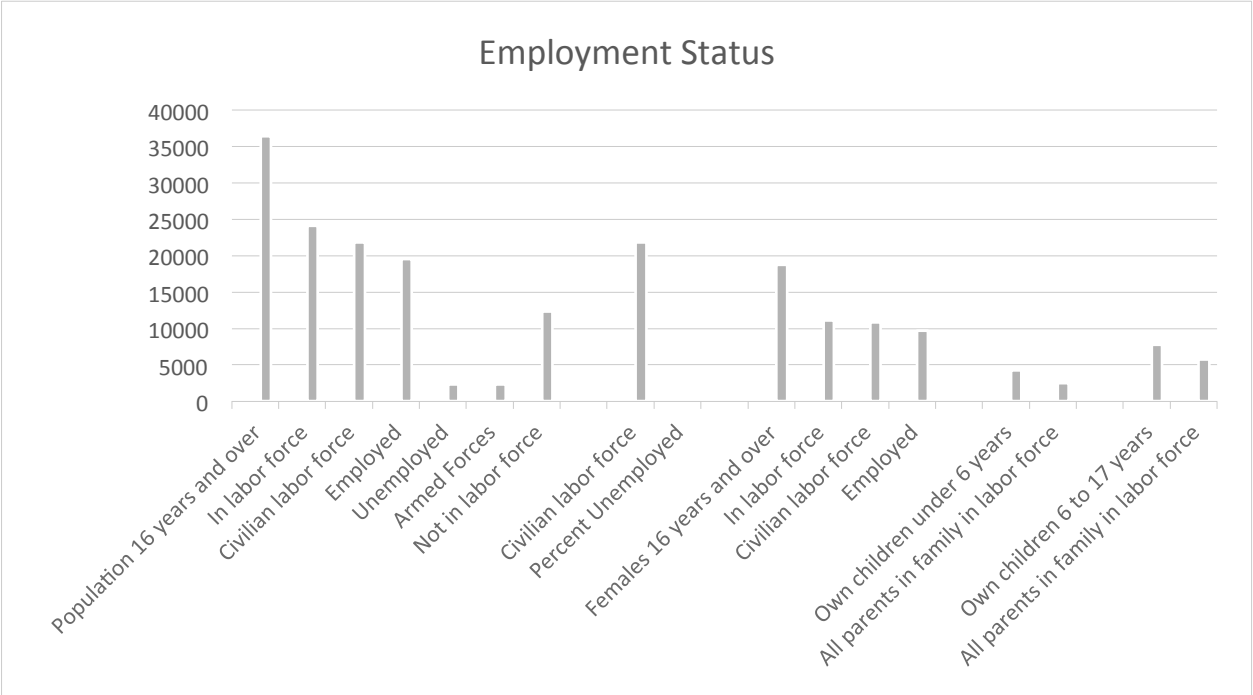
The median household income for the five-county study area is $50,352. The mean household income is higher, $62,618. However, the average *per capita* income in the study area is only $23,768. Interestingly, households with an average income of $50,000 to $74,999 make up the largest portion of the five-county study area, while households with an average income of $200,000 or more make up the smallest portion. Bryan County has the highest mean household and family income ($75,997 and $83, 867, respectively). McIntosh has the lowest mean household and family income ($52,480 and $55,724, respectively).

The average social security income is $16,250. McIntosh has the highest average social security income at $17,061, and Bryan County has the lowest at $15,535.

The mean retirement income is $22,994. Glynn County has the highest retirement income at $6,180, and McIntosh County has the lowest retirement income at $17,438.

The average public assistance funds received is $8,504. McIntosh County has the highest average public assistance funding at $8,054, and Bryan County has the lowest at $1,708. These findings are summarized in Graph 4.

Graph 5: Employment Status



Employment Status

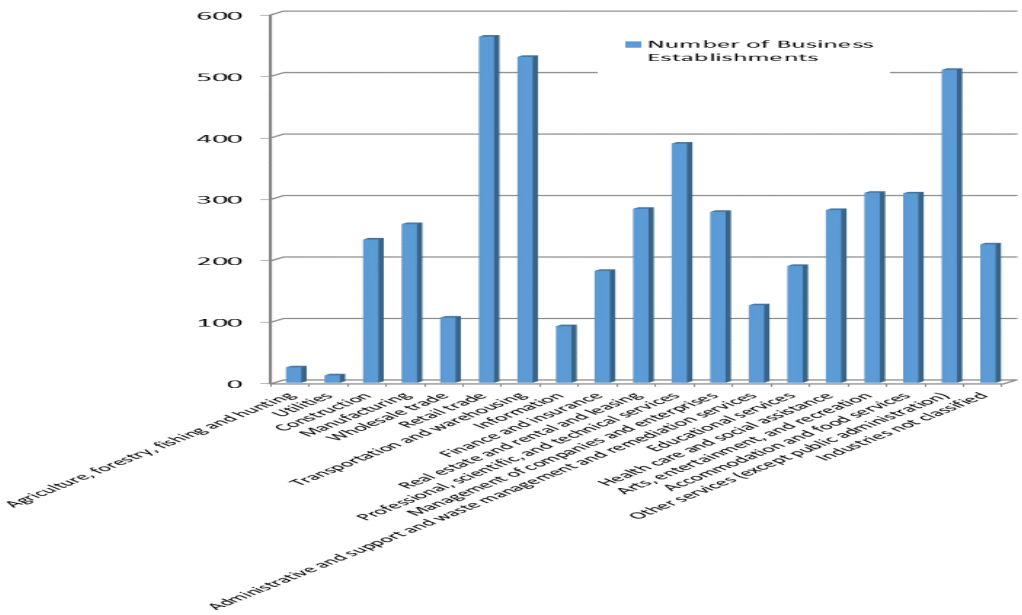
The population of residents age 16 and over in the five-county study area is 36,426. Of this population, 24,094 people are considered to be part of the labor force. Among those, 21,814 people are in the civilian workforce. Approximately 19,505 people are employed, 2,309 are unemployed, 2,279 people are in the armed forces, and 12,331 people are not in the labor force. Graph 5 illustrates these findings.

Graph 6: Class of Workers

Class of Workers

The civilian population in the five-county study area numbers 19,505. Among civilians, there are 13,644 private wage and salary workers, 4,825 governmental workers, 1,001 self-employed persons, and 34 unpaid family workers. Graph 6 illustrates the data.

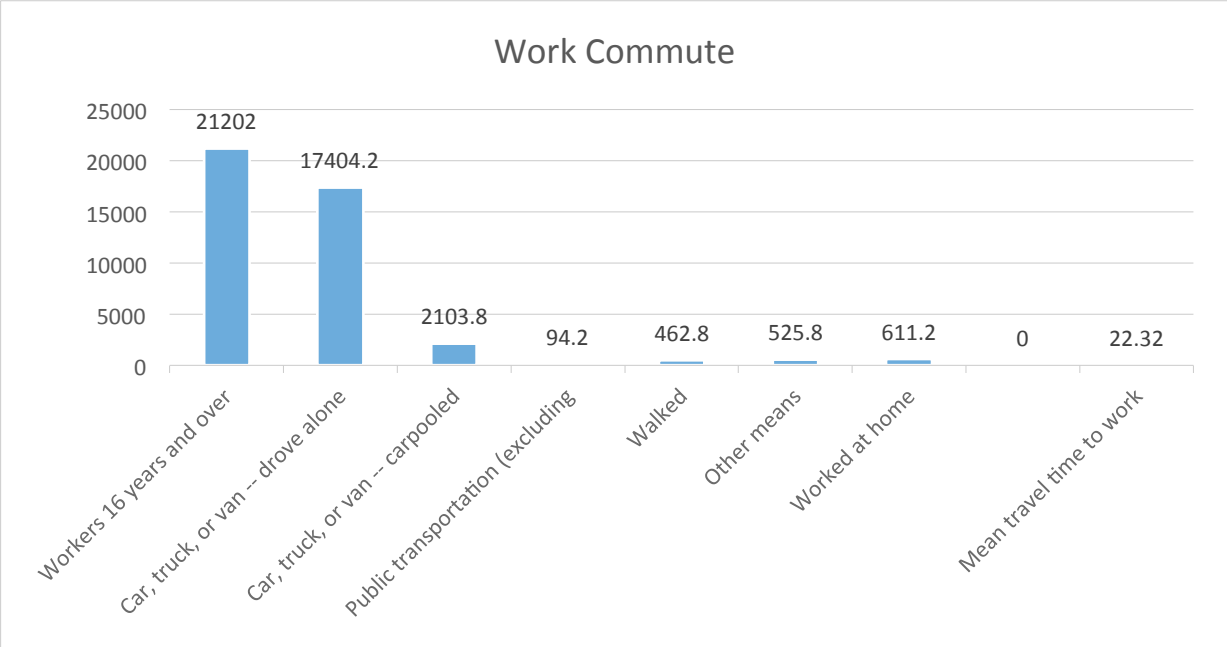
Graph 7: Number of Business Establishments



Number of Business Establishments

The largest industry in the study area is retail trade, and the smallest industry is utilities. There are 4,904 establishments in the region with a total of 19 NAICS codes. Industries include the following: agriculture, forestry, fishing and hunting, utilities, construction, manufacturing, wholesale trade, retail trade, transportation and warehousing, information, finance and insurance, real estate and rental and leasing, professional, scientific, and technical services, management of companies and enterprises administrative and support and waste management and remediation services, educational services, health care and social assistance, arts, entertainment, and recreation, accommodation and food services. Graph 7 shows the count of businesses within industries.

Graph 8: Work Commute



Work Commute

The average work commute for people living in the five-county study area is 22.32 minutes. Approximately 17,404 of the people that commute to work drive alone, 2,103 carpool, 94 people use public transportation, 462 people walk to work, 525 people use other means of transportation, and 611 people work from home. This form of "induced traffic" is a result of the development patterns that principally were created for automotive mobility (Duany et al., 2000). Graph 8 illustrates the means of transportation that workers utilize to commute to work in the study area.

NATURAL AND HISTORIC RESOURCES
(Prepared by: Kelly Howard)

There is a wealth of natural resources—ecological, economic, and recreational—for the inhabitants and visitors of the Coastal Georgia Region.

Sand dunes of Georgia's barrier islands.

The climate of the Coastal Region is classified as subtropical. Moderate temperatures and rainfall amounts create a humid environment ripe for tropical storm development. However, because of the barrier island complex and the contour of the eastern shoreline,

the region is less prone to hurricanes than many other coastal regions (GA DCA, 2005).

The geology and topography of the Coastal Region is distinguished by its sequence of barrier islands and expansive marshes. Fluctuations in sea level during the ice ages created a series of shorelines and barrier islands that appear today as sand ridges. More than half of the barrier islands are publicly owned and, except for Jekyll Island in Glynn County, none of the publicly owned islands are accessible by car from the mainland. These pristine islands are relatively undisturbed and serve as refuge for many species of wildlife (GA DCA, 2005).

Marshes are characteristic of Coastal Georgia.

The Coastal Region terrain is flat with a gradual incline moving inland. Most of the land area lies within the Federal Emergency Management Agency (FEMA) 100-year floodplain and as such is subject to building and development restrictions. The desire of many to live close to coastal waters is currently at odds with the need to protect and reduce development in these flood-prone and environmentally sensitive areas (GA DCA, 2005).

Sea turtles nest in the GA barrier islands.

Soil conditions in the Coastal Region are generally considered unsuitable for development because of poor drainage. Septic tanks often function poorly because of soil conditions or the seasonally high water table. Improperly installed and poorly maintained septic systems pose a threat to both ground and surface water in the region. Possible water contamination is an ongoing issue in the Coastal Region (GA DCA, 2005).

Development in the Coastal Region will most likely have a significant impact on the existing plant and animal habitat. Although the region has abundant marsh, estuarine, riverine, and maritime forest habitat that houses numerous plant and animal species, some of these species are considered by state and federal experts to be threatened or endangered. Inappropriate land uses and human activity are not heavily regulated, and there are few local measures to protect these resources. Sea turtles, for example, regularly come to Coastal Georgia to nest and are one of a handful of species protected by state and federal legislation (GA DCA, 2005).

Historic sites dot the area.

Historic resources of the Coastal Region are also plentiful, even though many are not given official "historic" status. Homes, churches, cemeteries, forts, plantations, and tabby ruins are found across the study area. These historic resources include natural sites that have cultural significance, such as Sapelo Island, St. Catherine's Island, Cumberland Island, and the state park, national park, and wildlife refuges dotting the terrain (GA DCA, 2005).

The allure of natural and historic beauty that abounds in the region draws thousands of recreational visitors to the area each year. Boating, fishing, bird watching, sun bathing, and site-

seeing are just a few of the tourist attractions in Coastal Georgia. Tourism is a significant part of the coastal economy. However, with increased visitors comes increased impact to the region's water supply and ecologically sensitive areas (GA DCA, 2005).

COMMUNITY FACILITIES
(Prepared by: Ashley Crain)

Education

Schools in the Coastal Region of Georgia are overcrowded due to the amount of growth the region has seen (GA DCA, 2005). Several institutes of higher education are located within the region: Armstrong Atlantic State University, College of Coastal Georgia, Georgia Southern University, Savannah College of Art and Design, College of Coastal Georgia, and Savannah State University (CRC, 2014 Economic). The Coastal Region is being well served by these institutions; however, there are still needs in certain communities, such as McIntosh County, for greater accessibility to the programs and services that these institutions provide. The need for more educational infrastructure and resources within the region will continue to grow as the population increases. The use of satellite campuses and online programs offers opportunity for areas where infrastructure is inadequate (GA DCA, 2005).

During the site visit to the Coastal Region, it was clear that many municipalities and county governments were anticipating institutions of higher education to be economic drivers. Liberty County, for example, is preparing for a new Armstrong Atlantic campus that will bring 4,000 students to the area. The City of Brunswick is also considering ways to attract students from the Coastal College of Georgia to the downtown.

Health Care

The region does not have a designated hospital or health center. However, Southeast Georgia Health System is a not-for-profit healthcare system that has campuses in Brunswick and St. Mary's (Camden Campus). They also have offices in St. Simon's Island, Brantley, and Darien. These facilities offer special services in senior care, cancer care, orthopedics, and spine care (SE GA Health System, 2014), This healthcare system works with different institutes of higher education, such as the radiology department at the College of Coastal Georgia, and serves the community's health care needs. The Coastal Regional Commission also facilitates special services for the aging population in the region, which is expected to be a growing demographic and an important planning area for the future of the Coastal Region (CRC, 2014 Economic).

Recreation

The Coastal Region houses many state and federal parks as well as historic sites. Overall, the existing facilities meet the needs of the region. There are current recreational projects and plans to develop recreational opportunities in the region, such as the Statewide Bicycle Pan, the Coastal Georgia Trail, and the Wiregrass Trail. These plans bring local governments and private interest groups together for a common goal. Additionally, miles of beaches along Coastal Georgia provide both passive and active recreational assets. It is important to note that there are limited

recreational opportunities for people with mental and physical challenges as well as the aging population (GA DCA, 2005).

Transportation

PORTS

There are two ports within Georgia's Coastal Region. The Port of Brunswick and the Port of Savannah act as major economic drivers for the region. Being both sizeable and stable, these ports offer high-paying jobs as well a serving businesses and industries throughout the region. This region is home to many manufacturing and distribution companies, so having easy accessibility to the ports helps these industries. While these ports are of great importance to the economic stability of the region, the required dredging to keep them in usable form raises concerns about environmental consequences (CRC, 2014 Economic).

INTRACOASTAL WATERWAY

The Atlantic Intracoastal Waterway serves as a water route and connector to the Atlantic Ocean for recreational and commercial uses (GA DCA, 2005).

MAJOR INTERSTATES

Both Interstate 16 and Interstate 95 are located in the Coastal Region of Georgia. Interstate 95 (I-95) has the most impact on the region as a whole. I-95 encompasses a total of 1,917 miles from Florida to Maine. Of these, 112 miles are located in Georgia. Many economic opportunities for the communities in the region run along this interstate, as it is traveled daily by many. I-95 acts as the major north-south corridor for the region, and I-16 acts as the major east-west corridor to the region. I-16 runs from Chatham County to Bibb County, with access to Interstate 75. This access is important because of the economic and political importance between Atlanta and the Coastal Region (GA DCA, 2005). An important minor north-south corridor that pre-dates I-95 is Highway 17, which connects coastal communities.

AIRPORTS

The Savannah–Hilton Head International Airport is the region's largest airport and is served by major carriers such as Delta and United. Brunswick is also home to an airport, Glynco Airport, which offers service to Atlanta and is served by Atlantic Southeast Airlines (GA DCA, 2005). On the south end of the study area, Camden County residents can readily access the international airport in nearby Jacksonville, Florida.

RAILWAYS

The region is served by three major rail providers: CSX (Seaboard Coastline), Norfolk Southern, and Georgia Central Railroads. Liberty, Bryan, Glynn, and Camden Counties all have access to freight rail, but McIntosh County does not. The railways in the Coastal Region have close relationships to the region's ports and military bases, aiding economic growth in the region (GA DCA, 2005).

REGIONAL COMMISSION PLANS AND PLANNING
(Prepared by: Holly Alderman)

Since 1964, the Coastal Regional Commission of Georgia (CRC) has provided comprehensive and specialized planning services in transportation, water resources, and historic preservation for 10 counties in the Coastal Georgia region, including Bryan, Bulloch, Camden, Chatham, Effingham, Glynn, Liberty, Long, McIntosh, and Screven counties (CRC GA, 2014 Home). It is a state-mandated body, funded by member dues. The Commission is also contracted by DHS to operate the Area Agency on Aging, which provides home and community-based services to seniors, those with disabilities, and their caregivers. The Commission is currently developing an Area Plan for Senior Services. The CRC facilities in Darien can host training sessions (e.g., AICP certification), and there is space for business "incubator" projects.

The literature on urban-region planning is clear that such agencies often have finite lifespans because of limited budgets and political power (Foreman, 2008). The longevity of this commission suggests that despite these handicaps, it is adept at providing regional thinking and planning in a meaningful way.

The CRC adopted the "Regional Plan of Coastal Georgia" in January 2012 (CRC GA, 2010). The plan establishes a "sustainable and environmentally-friendly" vision for the region, identifies regional issues and opportunities, and outlines an implementation and evaluation program to guide regional growth in ways that benefit coastal governments and residents. Counties in the region elect to establish Memoranda of Understanding with the CRC and adopt the plan. It was noted that neither the school board nor emergency management agencies participated in the regional plan. Compliance at the local level is monitored through a series of performance measures that ultimately impact grant eligibility, which serves as incentive to compliance. Other studies that the CRC has completed address transportation issues such as bike-pedestrian planning and safe routes to school, as well as urban forestry, coastal storm water (low impact development), community health, and green infrastructure. Currently, the CRC is interested in broadband planning for Coastal Georgia communities.

Several conditions and issues were highlighted during the February 6 site visit with the CRC Planning Director that are of particular note.

- Funding and political support for regional strategies and solutions for sustainable growth is a constant challenge. For example, the Transportation Investment Act of 2010 established transportation priorities but failed to garner public support. This is consistent with the literature on regional planning that a basic problem of regional councils is limited interests, power, and time of participants, all or most of whom are elected officials who are primarily loyal to their own jurisdictions (Knapp, 2011).
- LOST and SPLOST programs in individual municipalities across the region are actively supporting some development initiatives that are compatible with regional goals. For example, the City of Brunswick has a LOST project for additional parks.

- CRC collected Light Detecting and Ranging (LIDAR) data for the region in 2010.
- CRC has GIS data for all the counties in our study area except for Bryan. These range from road (provided by DOT), flood, soil, hydrology, parcel, census, land use, and school data, among others.
- CRC developed land-use maps for the region in 2010.
- Form-based code is applicable in coastal Georgia.
- There are demonstrations across the region of sustainable planning and development. For example, the City of Kingsland and the City of Brunswick have identified parcels for mixed-use development. Additionally, Garden City (Chatham Co.) received a Coastal Incentive Grant to create a "resilient community plan" in response to local threats such as sea level rise.
- Public engagement is encouraged and practiced in many planning efforts. For example, the City of Hinesville participates in an annual retreat with representatives from Ft. Stuart, Chamber of Commerce, Liberty County and other stakeholders to identify issues and goals in the county. Likewise, the City of Brunswick convenes a "neighborhood planning assembly" to addresses issues at a smaller scale.

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APPENDIX 1: Data Tables, Economic Profile

EMPLOYMENT STATUS	Bryan	Camden	Glynn	Liberty	McIntosh	Region Average
Population 16 years and over	22,713	38,564	62,538	46,874	11,441	36426
In labor force	15,802	25,735	40,165	32,546	6,223	24094.2
Civilian labor force	14,853	22,084	40,099	25,815	6,223	21814.8
Employed	13,512	19,848	35,871	22,741	5,556	19505.6
Unemployed	1,341	2,236	4,228	3,074	667	2309.2
Armed Forces	949	3,651	66	6,731	0	2279.4
Not in labor force	6,911	12,829	22,373	14,328	5,218	12331.8
Civilian labor force	14,853	22,084	40,099	25,815	6,223	21814.8
Percent Unemployed	(X)	(X)	(X)	(X)	(X)	
Females 16 years and over	11,702	18,931	33,318	23,836	6,071	18771.6
In labor force	7,238	11,132	19,691	14,220	3,046	11065.4
Civilian labor force	7,191	10,988	19,691	13,457	3,046	10874.6
Employed	6,462	9,726	17,806	11,533	2,787	9662.8
Own children under 6 years	2,682	4,566	5,579	7,490	847	4232.8
All parents in family in labor force	1,554	2,431	3,898	3,794	661	2467.6
Own children 6 to 17 years	5,990	8,193	12,071	10,886	1,734	7774.8
All parents in family in labor force	4,412	6,260	9,496	7,258	1,251	5735.4

INCOME AND BENEFITS (IN 2012 INFLATION-ADJUSTED DOLLARS)	Bryan	Camden	Glynn	Liberty	McIntosh	Region Average
Total households	10,952	18,152	31,137	22,991	5,086	17663.6
Less than $10,000	612	1,401	2,469	2,007	457	1389.2
$10,000 to $14,999	426	1,111	1,901	1,208	340	997.2
$15,000 to $24,999	990	1,813	3,651	2,615	731	1960
$25,000 to $34,999	807	1,381	3,329	3,193	653	1872.6
$35,000 to $49,999	1,538	2,649	4,222	3,810	860	2615.8
$50,000 to $74,999	1,999	4,289	5,274	4,724	841	3425.4
$75,000 to $99,999	1,856	2,810	3,798	2,650	711	2365
$100,000 to $149,999	1,760	2,021	3,964	1,839	399	1996.6
$150,000 to $199,999	590	412	1,281	610	47	588
$200,000 or more	374	265	1,248	335	47	453.8
Median household income (dollars)	63,818	54,155	49,986	44,295	39,506	50352
Mean household income (dollars)	75,997	61,002	68,786	54,828	52,480	62618.6
With earnings	9,183	14,987	23,834	19,827	3,507	14267.6
Mean earnings (dollars)	73,401	58,514	64,778	51,652	50,628	59794.6
With Social Security	2,541	4,450	10,662	3,811	2,263	4745.4
Mean Social Security income (dollars)	15,535	16,134	16,979	15,545	17,061	16250.8
With retirement income	2,056	4,109	6,180	4,217	1,598	3632
Mean retirement income (dollars)	24,651	23,523	28,093	21,269	17,438	22994.8
With Supplemental Security Income	339	503	1,582	782	307	702.6
Mean Supplemental Security Income (dollars)	9,212	9,032	8,575	7,919	6,986	8344.8
With cash public assistance income	75	386	484	236	70	250.2
Mean cash public assistance income (dollars)	1,708	2,376	3,045	3,397	8,054	3716
With Food Stamp/SNAP benefits in the past 12 months	1,023	1,980	4,140	2,649	697	2097.8
Families	8,471	13,478	21,342	17,228	3,460	12795.8
Less than $10,000	301	938	1,256	1,330	147	794.4
$10,000 to $14,999	179	410	911	570	144	442.8
$15,000 to $24,999	599	1,075	2,252	1,873	532	1266.2
$25,000 to $34,999	537	938	1,695	2,227	302	1139.8
$35,000 to $49,999	1,092	1,742	2,817	2,804	639	1818.8
$50,000 to $74,999	1,671	3,563	3,725	3,692	755	2681.2
$75,000 to $99,999	1,631	2,518	3,054	2,316	565	2016.8
$100,000 to $149,999	1,583	1,685	3,406	1,593	314	1716.2
$150,000 to $199,999	565	383	1,094	552	47	528.2
$200,000 or more	313	226	1,132	271	15	391.4
Median family income (dollars)	73,197	62,137	61,880	48,316	49,430	58992
Mean family income (dollars)	83,867	67,505	78,465	58,869	55,724	68886
Per capita income (dollars)	27,511	22,797	27,446	20,326	20,764	23768.8

Nonfamily households	2,481	4,674	9,795	5,763	1,626	4867.8
Median nonfamily income (dollars)	30,986	30,348	30,935	32,740	26,364	30274.6
Mean nonfamily income (dollars)	45,870	39,069	44,844	40,435	41,966	42436.8
Median earnings for workers (dollars)	32,999	29,471	28,164	28,378	21,457	28093.8
Median earnings for male full-time, year-round workers (dollars)	55,172	41,205	45,066	37,563	38,409	43483
Median earnings for female full-time, year-round workers (dollars)	35,713	30,703	32,291	31,767	29,256	31946

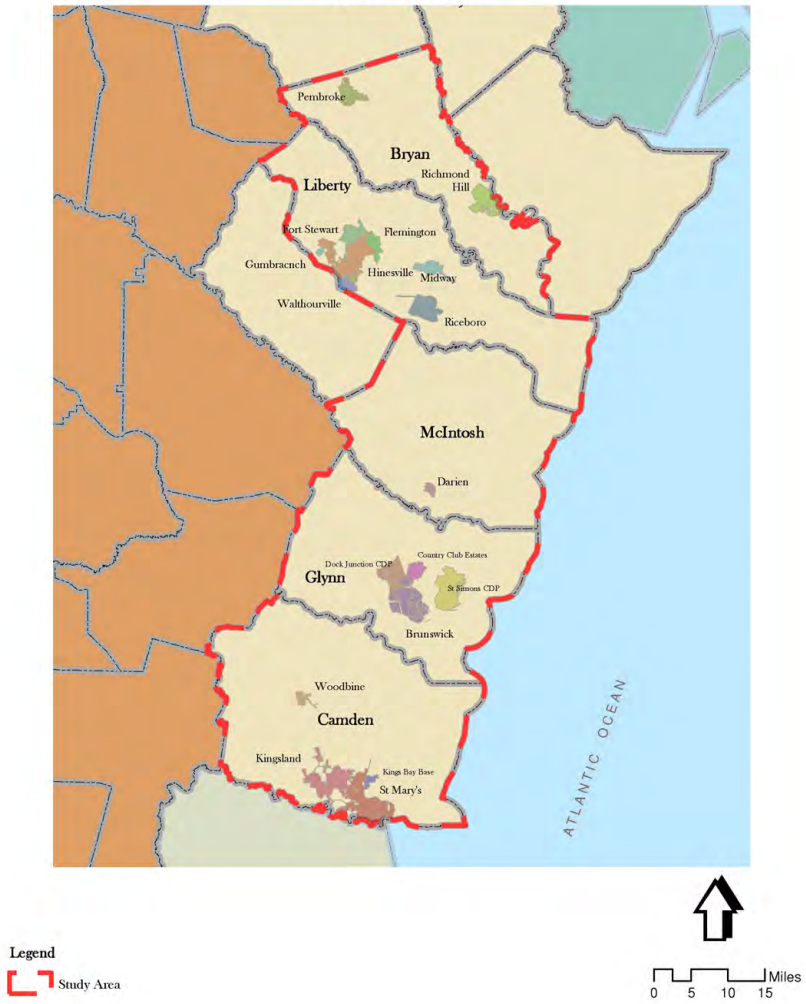
COMMUTING TO WORK	Bryan	Camden	Glynn	Liberty	McIntosh	Region Average
Workers 16 years and over	14,187	22,896	35,007	28,592	5,328	21202
Car, truck, or van -- drove alone	11,646	19,295	28,598	23,343	4,139	17404.2
Car, truck, or van -- carpooled	1,475	2,249	3,721	2,408	666	2103.8
Public transportation (excluding taxicab)	10	91	198	95	77	94.2
Walked	148	379	495	1,184	108	462.8
Other means	467	301	844	956	61	525.8
Worked at home	441	581	1,151	606	277	611.2
						0
Mean travel time to work (minutes)	27.8	21.5	19.5	20.0	22.8	22.32

Source: U.S. Census Bureau, 2010 County Business Patterns.
Source: U.S. Census Bureau, 2008-2012 American Community Survey

5-County Survey of Existing Conditions

(Bryan, Camden, Glynn, Liberty, McIntosh)

Coastal Georgia, USA



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List of Authors

Jelani Linder prepared the survey of Bryan County.
Holly Alderman prepared the survey of Camden County.
Kelly Howard prepared the survey of Glynn County.
Ashley Crain prepared the survey of McIntosh County.
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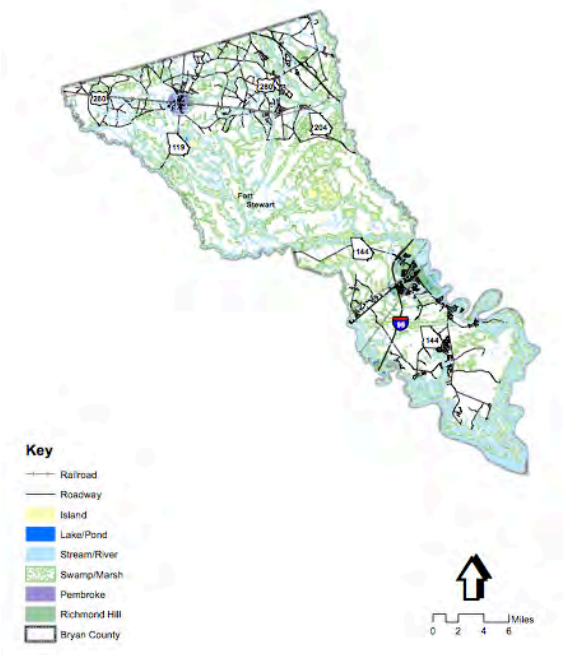
BRYAN COUNTY

Introduction

Bryan County is located in the Georgia Costal Region. It is surrounded by the following counties: Effingham County (North), Chatham County (Northeast), Liberty County (South), Evans County (West), and Bulloch County (Northwest). The county has an area of 454.5 square miles. Bryan County is separated into two parts, North and South Bryan County, due to the location of Fort Stewart in the middle of County. The County is part of the Savannah Metropolitan Statistical Area.



Map of Bryan County.

Bryan County was created December 19th, 1793 as an act of the General Assembly. The County was named after Jonathan Bryan, who lived from 1708-1793. Jonathan Bryan was born in South Carolina, but had strong ties with Georgia since the arrival of the first settlers in 1733. Bryan became famous for his support of colonist rights in Georgia. During Bryan County's development, the following land transfers occurred to form the current Bryan County: in 1794, a portion of Effingham County was transferred to Bryan County; in 1796, a portion of Bryan County was used to create Bulloch County; and in 1847, a portion of Bryan County was transferred to Chatham County.

Fort McAllister Civil War installation was located in South Bryan County. This military installation which was captured by General Sherman now serves as Fort McAllister National Park. The county seat which is currently in the city of Pembroke was not always the location of the county seat. In 1755, the county seat was established in the town of Hardwick. The General Assembly designated that a courthouse be established in 1797, two miles from the Ogeechee River at a place called the Cross Roads. In 1901, the county seat was moved to Clyde where a courthouse was built. In 1937, with the installation of Fort Stewart, the General Assembly designated the city of Pembroke to be the county seat.

Guale Indians inhabited Bryan County prior to Spanish settlement.

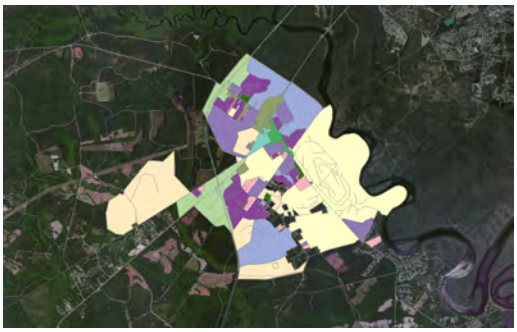
There are two cities in Pembroke, Richmond Hills in south Bryan and The City of Pembroke in north Bryan. The city of Pembroke was named after Judge Pembroke Williams, who was a prominent resident during the late 1800s. During the early days of Pembroke, it was known as a railroad hub for naval supplies and farm produce. Pembroke demographics are as follows:

- Population of Bryan County: 29,648
- Population of Pembroke: 2,499 (note says 2006 projection)
- Median Age: 31.8 years
- Median Income: $33,281
- Population Density: 63 people / square mile.

Prior to the 1500s, the Guale people inhabited the shores of the Ogeechee River, but during the late 1500s, Spanish exploration marked the beginning of change to this area. In the mid 1800s Bryan County became famous for its rice plantations, but after the Civil War and the destruction Fort McAllister the area experienced a down turn from the years of 1865 to 1925. In 1925, Henry Ford built a winter estate on Steling Bluff, a former plantation along the Ogeechee River. Ford's establishment of winter retreat brought about a revitalization of the area. Ford also established a school, built churches, trade schools, and homes for his 600 employees. The farms that Ford established transformed the rice fields into farms that produced iceberg lettuce and soybeans. In 1941, the area was named Richmond Hills.

<u>Issues & Opportunities</u>

The following list is based on interviews with Bryan County, Ray Pitman, County Administrator and staff. 2.6.2014



Zoning map, Richmond Hills, Bryan County.

1. Communication of emergency response
2. Storm water management and water treatment along southern Bryan County
    a. ICPR and SWIM storm water models used
3. Lack of participation on more dense lots
    a. Government sees value of density, but the community does not
    b. Government would like to educate the public more about density
4. Fort Stewart contributes to county economy
5. Working on being good neighbors with Fort Stewart
    a. They are increasing their boundaries, which minimizes how far the county can develop north of Richmond Hills
6. Looking to increase rooftops to enable more retail growth in county

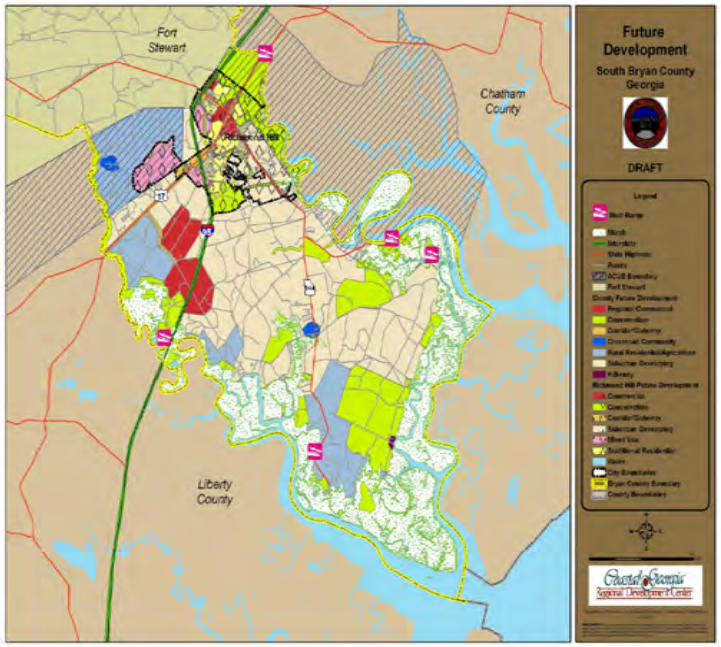
Plans and Planning

The following list conveys, in brief, the vision set forth by Bryan County and the cities of Pembroke and Richmond Hill to guide future development, per the Joint Comprehensive Plan.

1. Vision: To preserve and protect Bryan County's natural, cultural and historic resources, while promoting these amenities for tourism, recreational use and public enjoyment.
    a. Description/Location: Natural features and view sheds—coastal areas, marshlands, rivers, floodplains, wetlands, watersheds, wildlife management areas, barrier

islands, etc.—as well as other environmentally sensitive areas located throughout the County. Also areas designated as conservation lands, "in perpetuity."

2. Vision: To enhance mobility while creating an inviting and aesthetically pleasing entrance to Bryan County; where sense of place is balanced with economic opportunity and vitality.
    a. Description/Location: Areas of developed or undeveloped land adjacent to major thoroughfares—Interstates 16 and 95; U.S. Highways 17 and 280; Georgia Highways 67, 80, 144 and 204—that provide access to the County. This includes Exit numbers 87 and 90 on I-95 as well as Exit 143 on I-16.
3. Vision: To maintain the character of Bryan County's crossroads communities as development pressures increase, protecting these commercial enclaves while promoting opportunities for heritage tourism.
    a. Description/Location: Crossroad communities are located throughout the County, including Black Creek, Blichton, Dixie Daniel, Ellabell, Groover Hill, Groveland, Keller and Lanier. Primarily, these are commercial activity areas located at the intersection of highways with buildings in the center surrounded by open spaces. Some of these communities are in need of redevelopment.
4. Vision: To preserve the traditional character of this fishing village and its historic heritage along Georgia's coast; maintaining rural quality of life while promoting appropriate economic sustainability.
    a. Description/Location: Located in the southern end of Bryan County, Kilkenny is a unique vestige of a bygone era in coastal Georgia. A traditional fish camp and campground, the property has direct access to the Intracoastal Waterway. Future development is limited due to conservation land and the wildlife management areas surrounding Kilkenny. A historic home, built in 1837, is also located in this area.
5. Vision: To promote diversified economic and employment opportunities for Bryan County residents; to improve quality of life and strengthen the County's economic independence.
    a. Description/Location: Areas along major commercial/transportation corridors, such as the Interstate Centre along I-16 and Belfast Siding Road on I-95. Developed and undeveloped land on either side of these high traffic volume arterials. Varying lot sizes and densities, multi-story a mid-rise buildings; commercial, light industrial and distribution uses.
6. Vision: To preserve and protect the County's remaining rural character; to accommodate limited residential development with consideration to local practices of agriculture and forestry.
    a. Description/Location: Areas of undeveloped land likely to face development pressures for low density residential development. Typically, these areas have low pedestrian orientation and accessibility, large lot sizes, open space, and a high degree of building separation. These areas are also frequently used for agricultural, timber and forestry purposes.
7. Vision: To encourage livable communities where residential and commercial uses coexist; to maintain a level of density that is both appropriate and desired in unincorporated Bryan County.
    a. Description/Location: Areas where growth pressures result in typical types of suburban residential development. These areas are likely to be characterized by low pedestrian orientation, low traffic volumes and larger open spaces for recreation and outdoor use.



Future development map, South Bryan County.

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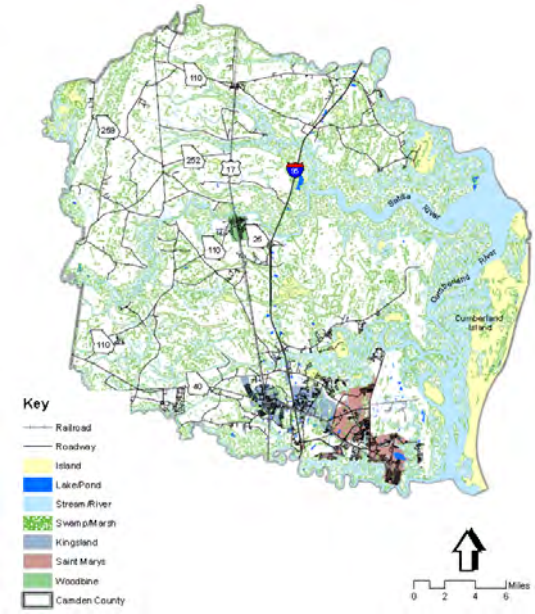
CAMDEN COUNTY

Introduction

Camden County is the southernmost county in the five-county study area on the Georgia coast, bordering Florida. The county encompasses three incorporated cities, Woodbine (county seat), St. Marys, and Kingsland. It also includes unincorporated Dover Bluff, White Oak, and Waverly communities. Kingsland and St. Marys are classic "main street" cities, committed to historic preservation and downtown revitalization (GA DCA, 2013).



Map of Camden County.

The land is drained by three major rivers, the St. Marys at the southern border, Satilla, and Altamaha at the northern border, creating three "peninsulas" along the eastern seaboard. There is a large barrier island, Cumberland, to the east. The county is transected by two major roadways, I-95 and HWY 17. To the west of these corridors, the interior of the county is characterized by poorly drained flatwoods, while the eastern areas are characterized by very poorly drained saltwater marshes and estuaries (USDA, 1977).

The county boasts a rich and diverse history. It was founded in 1777 by English settlers. The location had previously been occupied by French traders, Spanish missionaries, as well as native Creek and Timucuan Tribes (Kissinger, 2003). Over hundreds of years of continuous habitation here, the economy, transportation, and built environment have centered around natural resources. For example, the rivers have been used for transportation, the marshes and coast have been sources of aquaculture, while the wetlands and sandy areas have been used to cultivate products such as rice, cotton, corn and timber (Kissinger, 2003).

Public pier. St. Marys, Camden County, GA.

The large agricultural plantations have long since passed, but the local economy is still defined by its natural traits. Timber continues to be produced for export, and the seafood industry remains. The primary tourist attraction is Cumberland Island National Shoreline, accessible by ferry from St. Marys. Major employers include King's Bay Naval Base, local government, and a handful of large retailers (e.g. Wal-Mart, Publix).

The following table represents existing land uses in Camden County (Coastal GA RDC, 2013).

Land Use Categories	Acres	Percent
Residential	17,241	4.53
Commercial	475	0.12
Public/Institutional	10,050	2.64
Industrial	4,464	1.17
Parks/Recreation/Conservation	90,303	23.75
Agriculture/Forest	251,208	66.07
Transportation/Communication/Utilities	5,589	1.47
Undeveloped/Vacant	891	0.23
Total	**380,221**	**100**

Source: Existing Land Use Map, Camden County. 2007.

Current residents number approximately 50,513, and the population is expected to grow by 1.47% annually (US Census Bureau, 2010). Accordingly, the number of households, 18,047, is expected to increase 2.07% (US Census Bureau, 2010). The average household income in Camden County is $54,155 (US Census Bureau, 2010). Nearly 90% of residents over age 25 have attained high school or greater education, and approximately 20% have attained a bachelors degree or greater (US Census Bureau, 2010).

Issues & Opportunities

A site visit to Kingsland and St. Marys was conducted on February 7, 2014. A 3-member team met with John Peterson, Planning Director, at his office in Kingsland. The office of Planning and Development is organized under the County Board of Commissioners, and it handles zoning, code enforcement, building inspections, and business licensing. The County Commissioners also oversee the Joint Development Authority charged with promoting economic development and job creation.

Cumberland Island Visitor Center.
St. Marys, Camden County, GA.

As of 2013, the county was not part of a metropolitan statistical area (GA DCA, 2013). Given the population now exceeds 50k and is expected to grow, the question emerges as to the likelihood Camden County will be included in the nearby Brunswick/Glynn County MPO, which could bring more transportation investments

to the area and foster regional thinking and greater public engagement in transportation planning (Knapp, 2011).

The following is an inventory of existing conditions in Camden County organized under ten issues that emerged during the site visit. Given the limitations of the visit and project timeline, this is not an exhaustive list; nonetheless, it captures an "outsider's" perspective of the County as it is experienced in-person, through interviews, and through data collected from the County website and other on-line sources.

1. **Place Markers**
   - Cumberland Island National Shoreline
   - Character of historic cities, however no established historic districts or preservation commission in the County (Coastal GA RDC, 2013).
   - Green space (e.g., parks, Camden Preserve)
   - Public amphitheater, performing arts center
   - Abundance of cultural resources (e.g. midden on Grove Island)
   - Mix of colonial and Spanish mission design aesthetics (no design guidelines)
   - St. Marys Express offers themed excursions in partnership with St. Marys Little Theater, and "Theater By the Trax" utilizes the depot for special arts programs (St. Marys RR, 2014).

Public park, amphitheater. St. Marys.

2. **Natural Resources**
   - Cumberland Island National Shoreline.
   - Crooked River State Park
   - North Florida aquifer
   - Camden Preserve on river
   - DNR overlay for endangered species (e.g. sea turtles, long leaf pine)
   - Timber (biomass), agriculture, aquaculture
   - Wet areas not suited for urban development have good potential for parks and recreation, hardwood forests, and habitat for wildlife (USDA, 1977)

Extensive marshes in Camden County.

3. **Health**
   - General lack of walkability between residential, retail, employment centers.
   - The only sidewalks in the unincorporated County are within residential developments (Coastal GA RDC, 2013).
   - Attrition of agricultural land to developers.
   - Bike lane included in Colerain Road Bypass project.
   - The county has a general hospital and general nursing home.

4. Economic Development

- Heavily dependent on Kings Bay naval base for jobs (threat of contracting brigades).
- Less local economic development has occurred than was anticipated with the establishment of the naval base (the base contains housing, food, and retail opportunities that do not generate tax funding for the host community)
- Proximity to Jacksonville, FL (30 min. commute) benefits the County in terms of employment opportunities for its residents as well as access to the Jacksonville International Airport and cultural events and attractions.
- Cumberland Island attracts 40,000 visitors annually to Camden County and to St. Marys where they catch the ferry. However, the island is a national shoreline that cannot be developed for other uses that might benefit the local economy.
- Most of the county is not well suited for urban development because of tidal and stream flooding, and/or wetness in soils with clay. In general, soil with best potential for cultivated crops also have best potential for urban development. These include areas of fine sand, sand, dunes, and areas where the water table is at a greater depth (USDA, 1977)
- The impending FEMA flood insurance tax hike is not perceived as a threat.
- Kingsland hosts the College of Coastal Georgia-Camden Center. A local high school also serves as a trade school. The County is seeking funds for Altamaha Tech branch campus.
- "Labor ready" workforce may not be a fit for the "knowledge economy"
- The county has no general fund debt, short or long term (Camden Co., 2013).
- The LOST and SPLOST collections are down one-third from five years ago. These sales taxes have begun to hold steady at a flat collection rate and are no longer trending downward (Camden Co., 2013).
- Proposed use of grey field for space port project (ties with Kings Bay); possible growth in military service contractors
- Tourism economy fluctuates

St. Marys Railroad depot partners with "Theater by the Trax". Camden County, GA.

Historic St. Marys maritime village.

5. Housing

- Housing types are predominantly single-family with some multi-family, as well as subsidized housing.
- Some historic housing, neighborhoods, and parks (not all registered).

- Only small, residential developments (10 lots) allowed in areas not serviced by water-sewer service.
- For planned developments, developer can propose density.
- Existing senior center.
- Affordable single-family housing off of the naval base is scarce. Trend toward naval employees preference for rural, low-density residential housing (mobile home) in the county.
- Home sales mostly flat, and construction is almost non-existent (Camden Co., 2013).
- Mandated property value freeze enacted in 2006 for tax purposes (Camden Co., 2013).

Historic Spencer House in St. Marys serves as an inn.

6. Water & Sewer

- No water or sewer service in county, only in cities. Developers who can provide water-sewer can develop rural areas.
- Water quantity has limited daily draw (North FL aquifer)
- Water quality unstable (saltwater intrusion, aging/inadequate storm water infrastructure)
- Low areas on evacuation route(s) susceptible to flooding.

Evacuation route susceptible to flooding.

7. Demographics

- Population expected to grow 63% across the county, with the fastest growing city being Kingsland, followed by St. Marys and Woodbine (Coastal GA RDC, 2006).
- There is a young, transient population of naval base employees.
- There is racial and ethnic diversity in the communities, with historical discord and economic divides.
- Approximately 90% of the population achieve a high school diploma, and half of those will go on to post-secondary schools. 20% hold a bachelor or higher degree.

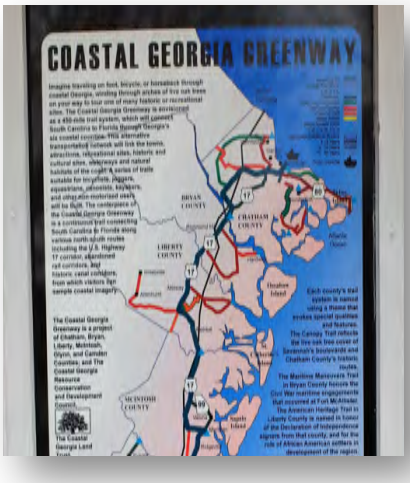
8. Public Awareness

- Planning staff engage with Chamber of Commerce and Development Authority.
- Camden Partnership provides information on economic impact of naval base.
- Officials desire to increase awareness of economic impact of different planning scenarios.
- Planning documents posted on county website.
- Coastal Georgia Greenway plan map posted at Gilman Memorial Waterfront Park, St. Marys.

9. Transportation

- Dominant mode is the automobile.

- No existing transit system. However, the Coastal Regional Coaches program services the county by demand-response at affordable fares (Coastal Regional Coaches, 2014).
- Interest in bikeways. Plan to participate in Coastal Greenway project.
- Colerain Road Bypass project will connect the high school with the naval base, will improve evacuation route, and will include bike lane (SPLOST).
- There are a few areas of traffic congestion that persist because of a lack of support/funding for improvements.
- The St. Marys Railroad services the naval base and has connectivity to main CSX lines (Camden JDA, 2014). Some existing line has in part been divested to land developers.
- General airport serves county; international airport in nearby Jacksonville, FL.



Camden County plans to participate in Coastal Greenway project.

10. Planning & Policy

- Unified County Code, Land Use Maps
- Limited participation in regional planning and programs. This is consistent with the literature on regional planning, that a basic problem of regional councils is limited interests, power, and time of participants, all or most of whom are elected officials with primary loyalties to and duties in their own jurisdictions (Knapp, 2011).
- Bicycle and Pedestrian Plan, 2005, identifies issues and opportunities for safe routes to school, additional sidewalks and shared use paths (e.g. rail corridors), roadway projects, as well as regulation and design guidance (Coastal GA RDC, 2005)
- Joint Comprehensive Plan ("Community Agenda"), 2007-2027, includes the vision, issues and opportunities for the county and its municipalities, with an implementation program, developed through a public process (Coastal GA RDC, 2006)
- Greenprint Model developed in 2008, identifying opportunities for land conservation, restoration and resource protection, new park creation and trail development (The Trust, 2008)
- Camden/Kings Bay Joint Land Use Study underway that will assist in formulating a smart growth plan to guide future development with emphasis on planning for land uses in the vicinity of the base that are sustainable and compatible with the military mission. The community and the military will study planning issues in an open forum. The final results of this study are expected by March 2014 (Camden Co., 2013).
- No ordinance or overlay districts to regulate aesthetics of development in highly visible areas, and no development guidebook (Coastal GA RDC, 2013)
- Mixed use development allowed. One mixed-use zoned development site in St. Marys currently on market (site of former paper mill) (Camden JDA, 2014).

Conclusion

Camden County is rich in history and has a distinct coastal setting that informs much of area's character and development. A majority of land use is in agriculture, forestry, parks, recreation, and conservation, with relatively little residential, institutional or industrial development. The population is expected to continue a pattern of growth over the next decade, and much of it will not be home grown. The issues that face the county and its municipalities span a range of conditions, as identified above from the site visit.

While "sustainable communities" seems to be a trajectory established by the regional plan to encourage maximization of existing infrastructure and forward-thinking capital improvements that support transit-oriented and mixed-use development, at the local level the application is quite different. For example, Camden County is focused on outsourcing and shared services (even for Planning & Zoning!), and developing a strong contingency fund—these are low-risk, almost survival-mode activities, rather than visionary steps toward smart growth.

Based on the initial survey of existing conditions in the 5-county study area including Camden County, perhaps the approach to follow is what Foreman calls a land-mosaic or puzzle-pieces plan, in which planning solutions are developed for small to mid-size areas that fit together to form the whole region (Foreman, 2008). This approach could equip the communities that are poised for sustainable growth with the concept(s) that they can "personalize" and put into motion, and perhaps yield momentum for the larger, regional sustainability goals.

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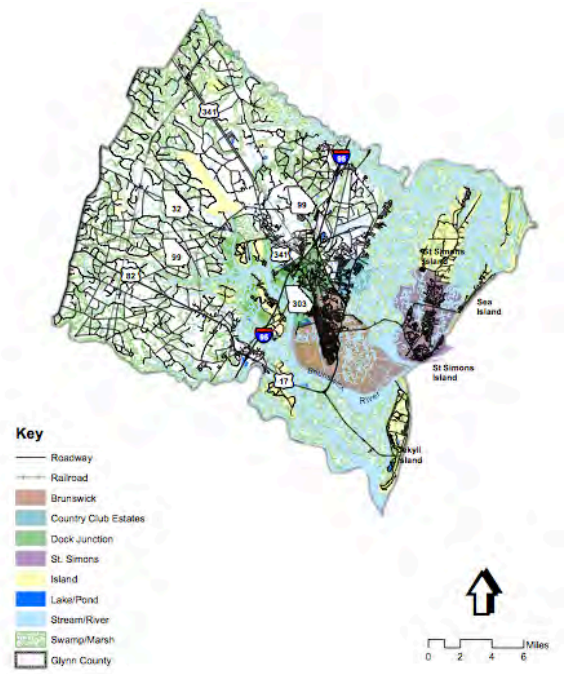
GLYNN COUNTY

Introduction

Glynn County is one of the southern counties within the Coastal Regional Commission of Georgia. It is bordered on the north by McIntosh County and Camden County to the south. To the west and northwest, Glynn shares a border with Brantley and Wayne counties (both of which were excluded from our study area.

The only incorporated city in Glynn County is the City of Brunswick. The county encompasses three signature coastal islands: Jekyll Island, Sea Island and St. Simons. The western portion of the county is primarily flatwoods that serves as timber resources while the eastern portions are a combination of saltwater marshes and tributaries. The county was founded on February 5, 1777, and named after John Glynn, a member of the British House of Commons (Gannett, 1905). Glynn County is one of the 8-original counties in Georgia (Gannett, 1905) and was occupied by the Indians of the Lower Creek Tribe (Cooksey, 2005).



Map of Glynn County.

Military has played a large role in Glynn County population. James Oglethorpe's regiment established Fort Frederica in about 1736, to provide a defense against an attack from the Spanish in Florida (Cooksey, 2005). In 1742, the Spanish unsuccessfully attacked the fortress in the Battle of Bloody Marsh (Cooksey, 2005). Oglethorpe's regiment would leave the fort after the invasion attempt which opened the door to other countries laying claim to its ownership. This military exit and unstable provincial ownership were contributing factors to the low population. Glynn County was sparsely populated before the American Revolutionary War and even those inhabitants fled the area during the conflict. Even though, many of these Revolutionary War veterans reestablished homesteads after the war, military again played a role in the declining population of the region (Cooksey, 2005). One likely unintended consequence of the sparse population, is that Glynn County was largely spared of William Sherman's march to the sea where other coastal Georgia cities were damaged by fire (Miles, 2002).

Fort Frederica

Glynn County still maintains a modestly low populated today compared to its coastal neighboring cities of Jacksonville, Florida, Savannah, Georgia, and Charleston, South Carolina. The population

trend has definitely had an effect on its land use and development patterns. Much of the county is developed in an urban sprawling pattern as much of the agricultural land ownerships convert to residential uses. Furthermore, the City of Brunswick which was established in the middle of the 19th century when development patterns were largely traditional and not oriented for automotive transport.

As with all communities, Glynn County future is largely dependent upon its economics. The county has to find ways to reinvent itself in the highly competitive market place of coastal cities but yet keep its proud history of its residents and maintain a stewardship over its natural coastal resources. The county's primary economic engines are tourism and roll-on/roll-off (ro-ro) port traffic.

Glynn County Courthouse

Sidney Lanier Bridge

Issues & Opportunities

Under the leadership of Professor Ron Thomas, FAICP, a site visit to Glynn County and Brunswick was conducted on February 7-9, 2014. A 3-member team conducted an interview survey meeting with unincorporated Glynn County and a 6-member team conducted an interview survey with the City of Brunswick.

The meeting with unincorporated Glynn County was conducted with Glynn County staff: Alan Ours, County Administrator and David Hanley, RLA, Community Development Director. The following issues and opportunities were identified:

- Economy is still struggling to find its way. They indicated that there are jobs but they are mostly below living wage standards. Economics is the primary focus of planning and administration staff.

- There appears to be opportunities countywide to create great new places. Many of the places that are in Glynn County appear to be in the city or barrier islands. Many of these places were established over 100-years ago. Newer developments are more suburban in nature, lack traditional design or architectural elements, and otherwise do not provide residents or visitors with an experience.

- Crime problems are ongoing. It seems as if young men are getting into trouble and they cannot get gainful employment because they have a criminal history. Thus perpetuating the criminal mischief.

- Expansion of the university is a possibility but the concentration of crime appears to be a major hindrance to expansion. This expansion could bring a younger group of residents to the area and much needed economic stimulus.

- History of consolidation with City of Brunswick was discussed. There have been two attempts and both failed. Glynn County is still open to it. Glynn County believe that it could be successful if Brunswick, kept their law enforcement and planning/zoning components. It appears from preliminary survey that the Glynn County would support this reformation but the City of Brunswick believes their interests would be misrepresented as is perceived in the current commission district alignment.

- Federal Law enforcement Training Center is a major economic engine. Its presence in the county is an excellent community asset to add to the regions strong military roots.

- Although Interstate I-95 goes through Glynn County, it isn't viewed as big of an asset as surrounding counties.

Brunswick, Georgia

The meeting with the City of Brunswick was conducted with City staff: William M. Weeks, City Manager, City of Brunswick, Arnie Glaeser, Planning and Development Manager, City of Brunswick, and Mathew Hill, Executive Director, Brunswick Downtown Development Authority. The following issues and opportunities were identified:

- Biggest issue was financing. They've had to make cuts to staff, projects and city investment in general. Public funding efforts haven't passed referendum.

- Opportunities for public/private and inter-governmental partnerships

- Expansion of the college into downtown is desired but hindered by crime and logistically getting students from the campus to downtown.

- Abundance of space downtown. Currently a liability but an opportunity.

- Discussed consolidation but misrepresentation is major restriction. They have explored this option twice and currently isn't being considered.

- Main economic engine is tourism. Particularly tourism surrounding people visiting Sea Island, St. Simon's and Jekyll Islands.

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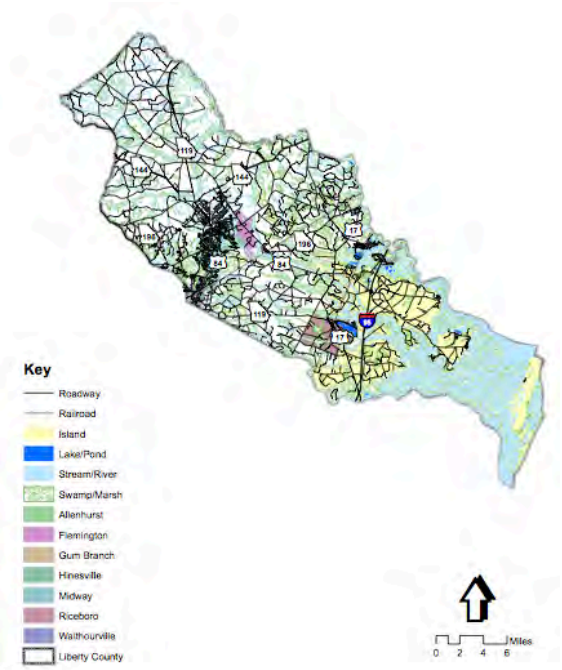
LIBERTY COUNTY

Introduction

Liberty County is located along the coast of Georgia. It is occupied by seven cities: Allenhurst, Flemington, Gun Branch, Hinesville, Midway, Riceboro, and Walthourville. In 1777, Liberty County was established and was one of the seven counties that were created from the original colonial parishes (Walker, 2004). At this time the county consisted of three parishes: Saint John, Saint Andrew, and Saint James. In 1799, Glynn County was enlarged using land from Liberty County. In 1793 and 1920 McIntosh County and Long County, respectively, were created using land from Liberty (Liberty Online, 2014).



Map of Liberty County.

The first elected governor of Liberty County was Lyman Hall, in 1783. During his time in office he was an advocate of public schools and helped charter the University of Georgia. He and Button Gwinnett, who was from St. Catherine's Island (of Liberty County) were signers of the Declaration of Independence (Walker, 2004).

Prior to the Civil War, cotton and rice plantations inhabited Liberty County. After the war, timber and turpentine industries replaced these plantations. These industries are still a large part of the economic base today (Walker, 2004).

St. Catherines Island is located in Liberty County-and is one of the eight barrier islands along the coast of Georgia. While several of the barrier islands have been developed, St. Catherines remains undeveloped. This is a privately owned island that is nearly eleven miles long. The island is managed by the St. Catherines Island Foundation and is designated as a National Historic Landmark due to its rich history (Seabrook, 2006).

Fort Stewart was built in 1940 as an antiaircraft training facility. This military base is the home of the Army's Third Infantry Division and has had a large economic role within the county since it was built. Being the largest military installation east of the Mississippi River, Fort Stewart encompasses nearly 280,000 acres of land and is encompasses by several different counties. Being only 40 miles southwest of Savannah, deployment can be rapid and easily accessed by interstate roadways and rail line (Pascoe, 2004). Between Fort Stewart and Hunter Army Airfield (Chatham County), over 20,000 active duty personnel are supported and 28,600 of their family members. Acting as a major economic developer for Liberty County and surrounding counties, 3,200 civilian workers are employed between the two military bases. Military bases bring expansion and economic growth to the surrounding regions. An increase in people means an increase in the need for housing, infrastructure, and schools. With this increase comes new jobs and more economic activity within these communities (Liberty, 2014). A joint land use study (JLUS) was created in 2005 for these

bases. This is a cooperative land use planning initiative between the U.S. Army and the surrounding municipalities. The objectives of this study were to encourage cooperative land use planning between military installations and the surrounding community and to seek ways to reduce the operational impacts of military installations on adjacent land. The plan consists of compatibility options and specific actions to be taken. The JLUS is a document that is created and maintained in order to preserve a good relationship between the military bases and the areas in which they are placed (Liberty Consolidated PC, 2014).

Land Use	Acreage	Percent
Residential	18,855	5.74%
Commercial	2,952	0.90%
Industrial	4,186	1.27%
Public/institutional	119,319	36.29%
Transportation/communication/utilities	480	0.15%
Park/recreation	352	0.11%
Dunes/marshlands/conservation areas	51,526	15.67%
Agriculture/forestry/undeveloped/vacant	131,098	39.87%
Total	**328,768**	**100%**

Source: LCPC Community Assessment Volume 1.

Issues and Opportunities:

A site visit to Liberty County and the City of Hinesville was conducted on February 7, 2014. Jimmy Adams, Holly Alderman, and Ashley Crain met with Jeff Ricketson of Liberty Consolidated Planning Commission and Billy Edwards, the City Manager of Hinesville. Vicki Davis with the Hinesville Downtown Development Authority also aided in the visit by giving us data.

- The seven cities that make up Liberty County are consolidated with the county
- Updates to the comprehensive plan are being started are required to be updated every year.
- The new comprehensive plan for the county will promote adherence to the Coastal Georgia Regional Plan.
- Fort Stewart acts as a huge economic base with over a billion dollar payroll per year
- Major employers: Fort Stewart, SNF (chemical company), Interstate Paper (paper company)
- Large industrial park, there is room for more industry to come in: this kind of development is wanted by the county

- Community wide annual retreat- Liberty County-wide Workshop: brings together key players in the county and municipalities in order to serve residents more efficiently
- Three initiatives/projects chosen to be implanted for the following year at the community workshop
- Purple Pipes, sustainable reuse water project, created from community workshop
- Easy access to I-95, beneficial for the residents that commute out of county for work
- Close proximity to ports and has rail system in place. This is beneficial for Fort Stewart as a means of deployment and package transportation.
- Aging population: Senior tax credit project
- Growth within county started in 1975 due to the installation of Fort Stewart. Noticeable growth has continued dramatically over the last ten years and projections show continued growth for the future
- There is not currently a county-wide sewer service offered, only by the individual cities
- Conservation lands: much of the area is covered in wetlands, this is a weakness for growth in those areas but a strength for the environment as a whole
- HAMPO: bus transit system for the City of Hinesville. Some people see program as a failure, others do not. Used by residents but routes have been cut down due to the amount of users.
- Needs/wants different types of businesses. More diversity in retail and restaurants establishments are wanted from the public
- Armstrong Atlantic State University is opening a campus in the Hinesville and will accommodate 4,000 students. This will also bring in more jobs and further economic strength within the county
- Quality affordable housing is needed

Plans and Planning:

Liberty County is a great example of a well-developed and maintained planning organization. This is apparent throughout the county and the City of Hinesville. The consolidation of county and city for planning purposes is surely the reason for this. The annual community wide workshop along with the creation of the LCPC allow for the municipalities and county workers to work together in order to serve the people of Liberty County best.

<u>The LCPC – Liberty Consolidated Planning Commission</u>

The Mission: *"To encourage and guide the local governments and the citizens within Liberty County in the creation, maintenance, and implementation of a shared, visionary, realistic, and feasible comprehensive plan which will provide all of our citizens and local governments with a holistic blueprint for our future growth and economic development that preserves and protects our natural resources while it ensures and enhances the quality of life for all of our citizens."*

The Liberty Consolidated Planning Commission was created in 2004 as one of the three projects that was chosen during the annual Liberty Countywide Workshop. This is a retreat style workshop that is attended by city and county government officials along with community members. Each year three projects are chosen for the following year. The goal of the LCPC is to both develop and maintain a comprehensive plan for the county and the communities in which it encompasses. Based on policy, goals and objectives are defined that guide the comprehensive planning process. Monthly meetings are held that are open to the public in order to have continued input and forward moving growth for the communities (Liberty Consolidated PC, 2014).

Liberty Regional Water Resources Council
The mission: *"To provide the forum for the cooperative planning and provision of water, wastewater and stormwater services for all local governments in Liberty County."*

The Liberty Regional Water Resources Council was born in 2009 out of the Liberty County-wide Workshop, as well. This organization was created to promote county-wide collaboration on providing sufficient quantity and quality of future public water supply to support future growth in the county (Liberty Consolidated PC, 2014). One project that has from this council is the Purple Pipe project. This is a project that is focused around reusing potable water. Due to saltwater intrusion, which occurs when freshwater is withdrawn from groundwater faster than it can be replenished, Liberty County has a limited daily withdraw amount from the aquifer. The purple pipes that name this project, hold reclaimed water which reduces the use of the water taken from the aquifer and also reduces the discharges to surface waters. This water is not drinkable but can be used for irrigation, aesthetic water bodies, environmental restoration and wetland creation, groundwater recharge and also industrial use. This is high-quality reclaimed water that is produced from treating domestic wastewater (Smith, 2011). This project has been implemented within Liberty County, however it is not county wide. The pipes run through Hinesville and into Fort Stewart at this time. Interstate Paper, a paper company located within the county uses 12 billion gallons of water a day. At this point the pipes do not reach to the paper plant, this is an opportunity for the LCPC and the Water Resources Council to continue the sustainable growth project (Liberty Consolidated PC, 2014).

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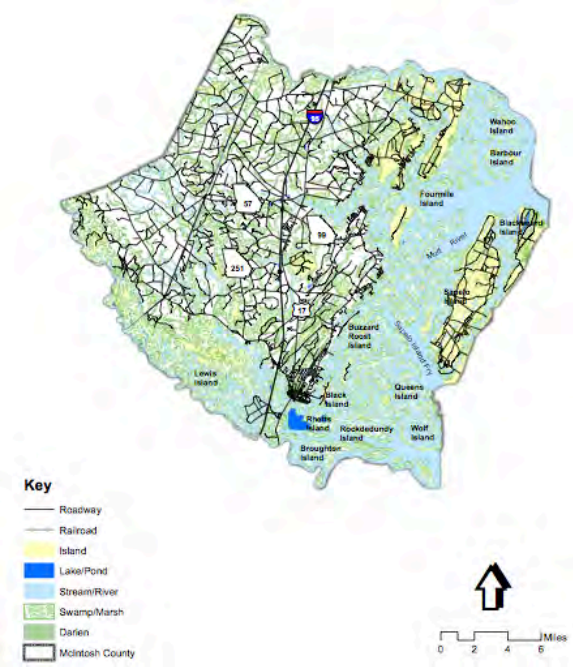
MCINTOSH COUNTY

Introduction

McIntosh County borders Georgia on its eastern lower coastal region, nestled between Liberty and Glynn Counties. It is part of the Brunswick, Georgia, Metropolitan Statistical Area which encompasses all of McIntosh, Glynn, and Brantley counties. It has seven unincorporated communities: Crescent, Eulonia, Townsend, and Valona, Shellman Bluff, Jones, and Cox. The county seat is Darien.



Map of McIntosh County.

McIntosh County is defined by the South Newport River to the north and the Altamaha River to the south. At the northern end of the county, Interstate 95 and U.S.17 enter at the middle of the county and cross the Altamaha River channels near Darien at the southern end.

McIntosh County is fronted by three barrier islands to the east: Blackbeard, a national wildlife refuge; Sapelo, a wildlife refuge and research reserve; and Wolf, a national wildlife refuge that is predominately tidal marsh. You need to charter a boat to visit Blackbeard Island. You can reach Sapelo by a ferry that carries tourists twice a week to the island. Wolf Island National Wildlife Refuge can be viewed from the water by private boat or charter. Harris Neck National Wildlife Refuge, located on the mainland, is very accessible and is excellent for bird watchers and naturalists.

McIntosh County offers the greatest diversity of attractions and the least foot traffic of any county on the Georgia coast. The county features several commercial fishing villages, three wildlife refuges, one marine sanctuary, numerous coastal restaurants, two historic forts, several antebellum rice plantations, and the Altamaha River. Because it is a little off the beaten path, McIntosh County still retains the flavor of the "good old days" on the Georgia coast, but this may be changing as development comes to the county.

Issues and Opportunities

The following section conveys existing conditions in McIntosh County as experienced during the site visit in February 2014.

1. The Built Environment
    - There is an abundance of areas with positive character such as Historic Downtown Darien
    - Spotty development patterns such as commercial buildings in and around historic areas have impacted the character of the city of Darien and the

surrounding communities
- Inconsistent use of building materials detract from the area's historic feel (design guidelines and sense of place)
- Primary corridors such Hwy 17 and Hwy 99 show serious blight and discourage windshield tourists
- Dilapidated storefronts, vacant buildings, and street and road disrepair along North Avenue running through Darien create a negative image of the community
- Signage on the outskirts of Darien and the surrounding communities don't invite passersby

2. History and Trends
   - McIntosh County has a rich history and many historical sites
   - There is a strong desire among residents in McIntosh County to preserve the traditions and heritage of the area
   - Not enough is being done by the local government to promote, protect, and preserve the historical integrity of the area
   - Residents are concerned that current "spot zoning" development patterns are negatively impacting the unique characteristics of the area
   - Rural sprawl is getting worse

3. Community Vitality
   - The community has a unique spirit with many citizens who are willing to participate in making it better. This needs to be celebrated and built upon.
   - Local government needs to focus on promoting the area's plentiful assets in order to protect its image
   - Vacant commercial areas impact people's perception of the area, and the County must carefully consider the right kinds of businesses to attract in order to restore vitality

4. Regional image and Identity
   - McIntosh County's economy is closely tied to the traditional occupations through its fishing and timber industries
   - The area's natural beauty and ecological assets create a distinctive atmosphere that defines it as a special coastal area
   - The county's proximity to Fort Stewart Army base in Liberty County and Kings Bay naval Submarine station in Camden County contribute to its Regional identity
   - The County lacks effective marketing, both internally and externally, to spread the word about what the County offers to existing or potential residents and businesses

5. Neighborhoods
   - A tree ordinance has been passed
   - Sidewalks are being built to connect neighborhoods and citizens to business
   - The area is an affordable place to live due to its competitive housing prices and low tax rate compared to surrounding counties like Chatham, Bryan, and Liberty
   - Communities in McIntosh County are tight-knit with many citizens that want to improve it

6. Resource Conservation and Heritage Preservation
   - There is an abundance of natural resources contributing to sense of place, open space, and regional identity
   - There is a strong desire among citizens to protect the natural beauty of the area
   - McIntosh County has a unique and rich cultural history which attracts tourists
   - There is an absence of designated historic districts
   - Sites of historic and cultural significance are not protected by ordinance and are vulnerable to incompatible development

7. Economic Development
   - The county is situated near and has access to two large ports and three interstate highways
   - There is on-going coordinated effort between the county and Coastal Georgia Community College to provide workforce training and development
   - A large industrial complex has been built to attract and house major industries
   - An Outlet Mall provides shopping and job opportunities
   - There county lacks a diverse job base
   - The lack of a skilled work force is a deterrent to attracting major industry
   - The county's traditional industry of shrimping and commercial fishing is currently recovering from significant economic decline
   - The county is willing to sacrifice some of its natural resources in order to attract major industries
   - Many business owners live elsewhere and are not invested in the community

8. Transportation
   - The county is easy to navigate and traffic congestion is minimal
   - Traffic flows efficiently on the existing roadways
   - Roads are generally well-maintained and designed to manage traffic flow
   - There is an adequate public transportation system
   - Sidewalks exist in the city of Darien and plans are in place to construct more

- The city has a bike path plan in place
- Providing public transportation to the areas of rural sprawl is expensive and problematic

9. Community Services
   - The county has many acres of natural open space that are protected by the state as well as permanent conservation provided by the Federal government
   - Local colleges provide opportunities for continuing education
   - There are excellent services for senior citizens provided by the region

10. Governmental Relations
    - Development pressures have provided an increased need for the county to think regionally, especially in issues such as land use, transportation, and housing
    - McIntosh County is part of the Regional Comprehensive Plan and related Short Term Work Program
    - The county participates in the Georgia Department of Economic Development's regional tourism partnership
    - The county participates in regional economic development and regional environmental organizations and initiatives, especially regarding water quality and quantity issues
    - There are limited financial resources to provide the services necessary for an increased population

<u>Sources</u>

McIntosh County Partial Comprehensive Plan Update {Grant Services & Consulting, Inc.)
Stakeholders: Brett Cook, City and County Manager; Wally Orrell, Industrial Development Authority
U.S. Census 2010

APPENDIX 1: DATA BY COUNTY

BRYAN COUNTY

Geography
Bryan County 454 square miles,
Richmond Hill 14.58 square miles
Pembroke 8 square miles
Elevation 14'
Interstate 95 1.3
Interstate 16 13.7
US Coastal Highway 170

Land/Water Area
Richmond Hill 130.3 square miles (land area)
Pembroke 141.2 square miles (land area)
Richmond Hill 0.2 square miles (water area)
Pembroke 0.3 square miles (water area)

POPULATION
Metropolitan County in 2010? YES
Total number, 2010 Census 30,233

DEMOGRAPHIC PROFILE
BRYAN CO. GEORGIA TOTAL Avg. Co. in GA

- Persons per square mile, 2010 Census 69.3
- Rank of population density, 1=highest (1-159) 75 -- --
- % Urban, 2010 47.7
- % Rural, 2010 52.3
- Rate of natural increase per 1000 pop., 2010-2011 8.6
- Rate of net migration per 1000 pop., 2010-2011 23.0
- Total number, 2011 Census Estimate 31,377
- % Black alone 15.2
- % White alone 80.0
- % other races alone 2.3
- % Hispanic/Latino 5.2
- % Age 65 and over 9.6
- Median age, Total 35.1
- Total, 2015 projection (GA OPB, 2012 series) 33,510
- Total, 2030 projection (GA OPB, 2012 series) 44,465
- Total civilian veterans, 2012 estimate 2,720

ECONOMICS

- Deposits of all FDIC Insured Institutions, 2011 $380,118,000
- Bankruptcy filings per 1,000 population, 2011 6.1
- Gross tax digest 40% value of assessed property, 2011 $1,306,076
- Taxes levied, 2010 $31,429,965
- Millage rate, county-wide, 2011 23.687 -- 27.881
- Total lottery sales, FY2012 $13,526,540
- Per capita lottery sales $431 $391 $452
- Median household income, 2010 model-based estimate $65,478
- Persons below poverty level, 2010 model-based estimate 3,560
- % of all persons 11.8
- % of children 0-17
- Per capita income, 2010 $39,394
- Total personal income, 2010 $1,197,226,000
- Transfer receipts, 2010 $177,146,000
- Transfer receipts as a % of total personal income 14.8
- Per capita transfer receipts $5,829

LABOR

- Civilian labor force, 2011 15,459
- Average annual unemployment rate 8.3
- Average # of business establishments, 2011 633
- Average monthly employment 5,834]
- Average weekly wage, all industries $585
- Resident workers age 16+, 2006-2010 13,962 4,241,387 26675.4
- % of residents working outside of county 70.4 41.3 45.8
- % or residents driving alone to work 80.8 78.7 79.5
- % of residents working at home 3.9 4.5 3.3

Distance to Major Cities:

- Savannah (13 miles)
- Macon (167 miles)
- Atlanta (250 miles)
- Hilton Head, South Carolina (59 miles)
- Charelston, South Carolina (121 miles)
- Jacksonville, Florida (120 miles)
-

Savannah Port Authority

- Port Authority (20.3 miles)

Air Transportation

- Savannah/Hilton Head International
    - 17.3 miles
    - Runway Length 9351 x 150ft/2850 x 46m (longest)
    - Runway Surface Grooved Concrete

- Hinesville Airport
    - 36.6 miles
    - Runway Length 3698 x 75
    - Runway Surface Paved

Military Installations

- Ft. Stewart 25 miles
- Hunter Army Airfield 13.7 miles

Climate

- Average Annual Temperature 78 degrees
- January Average High 60, Low 38
- July Average High 92, Low 72
- Annual Rainfall 49.58"
- Annual Snowfall None
- Prevailing Wind Direction NW

Government

- Richmond Hill Mayor and City Council
- Pembroke Mayor and City Council
- Bryan County Board of Commisioners

Medical Hospitals

- Memorial Helath University (Savannah)
    - 530 beds, Tertiary Care, Level 1 Trauma
- St. Joseph's Hospital (Savannah)
    - 350 beds
- Candler Hospital (Savannah)
    - 331 beds

Schools

- Education (Primary-High School)
    - Lanier Primary
    - Bryan County Elementary
    - Bryan County Middle School
    - Bryan County High School
    - Richmond Hill Primary School
    - Richmond Hill Elementary School
    - Richmond Hill Middle School
    - George Washington Carver Elementary
- Montessori School
    - The Ford Company
- Colleges & Universities within 25 miles
    - Savannah College of Art & Design
    - Savannah State University
    - Armstrong Atlantic State University

- Savannah Technical College
- Brewton-Parker College
- Strayer University
- University of Phoenix
- Georgia Southern University (60 miles)

Attractions and Mueseums

- Fort McAllister Stae Park
- Richmond Hill Historical Museum
- J.F. Gregory Park
- Historical Moments
- Tour of Homes

Recreational Facilities

- Ft. McAllister State Park
- Richmond Hill Recreation Center
- Richmond Hill Teen Center
- Pembroke Community Center
- J.F. Gregory Park
- D. Henderson Memorial Park
- YMCA
- Richmond Hill Area Tennis Association

CAMDEN COUNTY

Historical highlights:

1500s	Spanish mission/fort on Cumberland Is.
1777	county founded (Woodbine, County seat)
1792	St. Mary's established on abandoned Timucuan Tribal village
1802-66	Dungeness Plantation on Cumberland Is.
1812	St. Mary's captured by British (War of 1812)
1861-65	St. Mary's waterfront destroyed by Union gunboats in Civil War, town and churches burned
1877	Free land offered to settlers
1881-1972	Carnegie Plantation on Cumberland Is.
1972	Cumberland Is. National Seashore established
1978	Kings Bay Naval base established (1980 – becomes submarine base), 16k acres w/ 4k acres of wetland

State Region: Coastal, super region #12

Economy:

-Industries: government, hospitality, arts, health care, professional/admin, IT, logistics, retail, wholesale, manufacturing, construction
-products: timber, paper, turpentine, fishing, cotton, tobacco, fertilizer, chemicals
-Naval base: Kings Bay
-opportunity to expand military contractors and R&D companies in Camden Co. related to the naval base
-Private companies with 100+ employees: Express Scripts, Lockheed, Wal-Mart, Winn Dixie, Publix
-Total tax: 7% (state 4, local 3)
-Employment
  -18,272 employed (2011); 1971 unemployed
  -employment growth 29%, unemployment rate 3.6%
  -8.5% goods; 57.9% services; 33.5% gov't
  -avg. weekly wage $744-67
  -median household income: 49,230 (2010) - $53,009 ($27,019 per capita)
  -families below poverty level: 12.6%

Natural resources:

-58% forested
-168.8 sq mi of water
-produce 13M tons of biomass (timber)
-draws primarily from ground water (north Florida aquifer), public supply twice as much as domestic and commercial supply combined (130 gal/day/capita)
-major rivers: Little Satilla, Big Satilla, Crooked River, Cumberland River, St. Mary's River, Little St. Mary's River
-Cumberland Island Natural Shoreline

Population and Demographics:

-50,513 (2011), an increase of 16% from previous census
    -expected pop growth of 54-63% by 2030
-Ages
    -0-19: 29%
    -20-39: 30.6%
    -40-59: 25.7%
    -60 up: 14.3%
-Education
    -89.1% high school graduates
    -82.4% HS graduates with college prep endorsement (36.5% HOPE eligible, 44% go on to post secondary school)
    -20.4% bachelor or higher degree
    -10.9% less than high school education (of persons over age 25)
-Work Ready Certification: 41% of workforce
-avg. household size: 2.71 persons (mainly married couples, married couples w/ children)
-avg. family size: 3.17

Environment:

-St. Mary's, Satilla, and Cumberland-St. Simons watersheds
-St. Mary's and Satilla River basins
-high to average groundwater pollution susceptibility

Land use (613 sq mi of land):

-Residential:
    -construction in 2011 was all single-family
    -density/sq mi: 35.3
    -housing 65-35% split between owner- and renter-occupied
    -avg. mortgage $1259, rent $789
    -median home value $149,410-161,900
    -millage rate: 26.95 (2011)
-Agricultural: <5% of land
-Commercial:
-Institutional:

Recreation, open space, green infrastructure:

-Camden county recreation center
-Cumberland Island National Seashore

Transportation:

-major corridor: I-95
-rail
-75% work in county of residence
-85% drive to work alone; less than 1% use public transport
-55% commute <20 min.; 45% commute >20 min.

-daily vehicle miles traveled: 2,175,000
-68.5% occupied housing units have 2+ vehicles

County facilities/Infrastructure:
-12 schools, 100% achieving Adequate Yearly Progress
-College branch campuses: College of Coastal Georgia (Brenau, Troy, Valdosta State, and Waycross College offer distance education)
-Altamaha Technical College, Okefenokee Technical College
-served by Three Rivers Regional Library System
-one general hospital w/ 40 bed capacity (777 people/physician)
-one general nursing home w/ 78 bed capacity
-13 licensed day care centers
-one general aviation airport

Cultural resources:
-performing arts center, museums, art galleries
-historic architecture (no historic district)
-native American archaeological site(s)

SPLOST projects in the works:
-Colerain Road (Kingsland Bypass) Hurricane Evacuation Rt. and Economic Corridor, $750,000

Special notes:
-Region 12 crosses 5 senate districts and 2 congressional districts

Planning and other stakeholders:
-Dept. of Planning & Development
-Mary Hoover (912)729-5603, mhoover@co.camden.ga.us
-John Peterson (912)729-5603, jpeterson@co.camden.ga.us
-Planning Commission
-Joint Development Authority (assist businesses locate and expand in the county)
-The Camden Partnership (advocate, support, and strengthen military missions)
-Camden County Chamber of Commerce
-Coastal Regional Commission
-Southeast GA Joint Development Authority

<u>Sources</u>

4. UGA Cooperative Extension, Carl Vincent Institute of Government. The Georgia County Guide. 2013
5. Digital Library of Georgia
6. Georgia Archives, University System of Georgia

LIBERTY COUNTY

Economy:
- Industries: government, hospitality, health care, professional, industry
- Military Base: Fort Stewart
- Employment grew 78% from 1990-2007
- 71% of residents are in the workforce
- Economic resources: LCDA (Liberty County Development Authority), two post-secondary schools: Armstrong Atlantic and Savannah Technical College
- Three largest employers: Fort Stewart, SNF, Interstate Paper
- Per capita income (2010): $26,911
- Average annual unemployment rate (2011): 9.7%
- Average weekly wage (2011): $707
- Percentage of residents working outside county (2006-2011): 24.3%

Natural Resources:
- Dunes/marshlands/conservation: 15.67%
- Agriculture/undeveloped/vacant: 39.87%
- Annual rainfall: 50inches
- St. Catherine's Island: 14,000 acres of island owned by private foundation for research T
- Total square miles (2010): 602.5

Population and Demographics:
- Population: 65,451
  - White: 29,881
  - Black or African American: 26,805
  - American Indian: 358
  - Asian: 1,247
  - Native Hawaiian: 392
  - Some other Race: 1,810
  - Two or More races: 2,960
- High school completion % (2011): 67.3%
- Bachelor's degree and higher holders (2006-2010): 16.3%
- Housing unit density per square mile (2011): 55.8
- Number of households (2012): 22,991
- Annual growth rate: 1.35%
- Vacant housing, % total housing units (2010): 17.1%
- Mobile homes, % of total housing units (2010): 19.7%

Environment:
- County does not have natural resource inventory.
- Wetlands, marshlands, and floodplains have been identified using GIS
- County does have a tree preservation ordinance
- County does have three replanting ordinances for developed areas.

- Climate: subtropical/moderate
- Annual rainfall: 50 inches
- No surface water supply or river corridor
- Dependent on water from wells and upper FL aquifer
- Limited groundwater recharge areas

McINTOSH COUNTY

	McIntosh	Rank	Median	Georgia
Agriculture –				
Total farm gate value of production ($000), 2011	$6,624	151	$51,737	$12,953,313
Courts & Crime –				
Arrests per 100,000 population, 2011	980.9	102	$823.6	1,084.5
Economics –				
Per capita income, 20110	$22,346	148	$27,931	$34,747
Education – County Public Schools				
High school completion %, class of 2011	76.9%	36	71.1%	67.5%
Percentage of population (age 25+) with a bachelor's degree or higher 2006-2010	12.9%	85	13.3%	27.2%
Government –				
Countywide millage rate, CY 2011	27.6	77	28.1	28.2
Percentage of registered voters voting in 2012 General Election	70.8%	16	72.2%	72.2%
Health –				
General hospitals, 2011			1	147
Ratio of persons to total number of Physicians, 2010	7,166.5	138	1,230.0	488.5
Housing & Households –				
Housing unit density per sq. mile, 2011	22.7	60	29.2	71.3
Vacant housing, % of total housing, 2006-2010	10.8	34	13.8	12.3
Mobile homes, % of total housing, 2006-2010	39.2	124	23.3	9.9
Labor –				
Avg annual unemployment rate, 2011 10.7	13	10.6	9.8	
Average weekly wage, 2011	$538	121	$590	$867

Percentage of residents working outside of county, 2006-2010	67.9%	144	46.5%	41.3%
Natural Resources –				
Total square miles, 2010	285.6	18	346.7	59,425.2
Population –				
Total population, 2011	27,921	63	22,567	9,815,210
Public Assistance –				
Transfer receipts, % of total personal Income, 2010	24.8%	55	28.2%	17.8%
Transportation –				
Total highway mileage, 2011	348.57	65	606.70	119,442.13
Vital Statistics –				
Unwed mothers, rate per 100 live births, 2010	53.6	117	45.8	41.5
Teen pregnancy rate, 2001-2010	32.6	47	38.3	34.2

Produced for the Coastal Regional Commission by the Gwinnett Studio I Class at the University of Georgia

A Regional Sustainability Plan for COASTAL GEORGIA

Beautiful Beaches

Historic Grounds

Pristine Marshes

Vibrant Waterfronts

Ellabell
FEED & SEED
Nutrena

regional strategic planning for coastal Georgia

regional sustainability plan

coastal georgia

As part of the project timeline, from February 6–8, 2014 the team visited the five-county study area in Coastal Georgia, and met with planning agency staff and other county and municipal officers to gain insight into the conditions, issues, and opportunities. Additionally, the team gathered first-hand images and impressions of existing development types and patterns, local attractions, and the natural environment.

The team would like to acknowledge the following people for their support of this learning exercise in regional planning:

Coastal Regional Commission
Lupita McClenning, Director of Planning and Government Services

Coastal Georgia Historical Society
Mimi Rogers, Curator

Bryan County
Ray Pitman, County Administrator

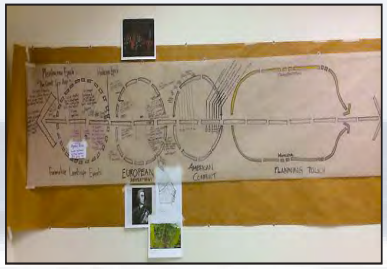
Camden County
John Peterson, Director of Planning and Development

Glynn County
William M. Weeks, City Manager, City of Brunswick
Alan Ours, County Manager
Arnie Glaeser, Planning and Development Manager, City of Brunswick
Mathew Hill, Executive Director, Brunswick Downtown Development Authority

Liberty County
Jeff Ricketson, AICP, Executive Director, Liberty Consolidated Planning Commission
Joey Brown, County Administrator
Billy Edwards, City Manager, City of Hinesville

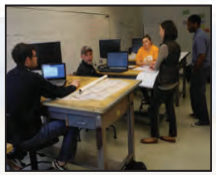
McIntosh County
Brett Cook, County Manager

Project Timeline



Initial Project
HISTORICAL TIMELINE

Assignment 2
SURVEY OF
EXISTING CONDITIONS



Assignment 1
I-95 SUSTAINABLE
CORRIDOR PLAN

PUBLIC PARTICIPATION
PRESENTATION
The Center, Covington, GA
Mar 29

Assignment 5
SCENARIOS REPORT

Week 2 | SURVEY | Week 5 | Week 7 | SCOPE | Week 10 | SCENARIOS | Week 14 | PLAN | PRESENTATION

JAN | FEB | MAR | APR | MAY

Week 4 | Week 8 | Week 11 | Week 16

Initial Project
COUNTY ASSIGNMENTS

COASTAL GEORGIA
FIELD TRIP
Feb 5 - Feb 8

Assignment 3
SWOT REPORT

Assignment 4
VISION, GOALS & OBJECTIVES

REGIONAL SUSTAINABILITY PLAN
PRESENTATION
Gwinnett County, GA
May 3

Street corner in St. Simon

sustainabl
commun

executive summary

The Regional Sustainability Plan for Coastal Georgia is the culmination of a 15-week graduate course in regional planning. For the student planning team, it provided a comprehensive introduction to the players, problems, environments, and practices that are unique to planning in Coastal Georgia, as well as an opportunity to become familiar with the process of developing a regional plan. The faculty and professional staff who guided the team and served as resources to the project made an invaluable contribution to the preparation of tomorrow's planners.

Coastal Regional Commission OF GEORGIA

executive summary

Rather than an actionable plan for the region, which would normally take years to develop, The Regional Sustainability Plan for Coastal Georgia, casts a unique portrait of the region through multiple lenses—academic, "neutral" observer, sustainability—that lend the resulting insights and recommendations an enthusiasm and creativity that can at times only be found in this type of endeavor.

The UGA Gwinnett MEPD team meets with Lupita McClenning of the Coastal Regional Commission in Brunswick, Georgia

The plan begins with a brief overview of the team's findings from site visits to the area, including input from local experts. After meeting with the Coastal Regional Commission (the quasi "client" of this planning exercise), it was agreed that the constraints of the project timeframe and team size justified limiting the study area to five counties along the coast of Georgia (Bryan, Camden, Glynn, Liberty, and McIntosh). Furthermore, it was agreed that the guiding principle for the study be sustainability, "ensuring that the land we build on is clean or will be clean; the investments we make in neighborhoods help residents lead healthy, safe, affordable, productive lives; the buildings we invest in are energy efficient and healthy; and the regions we support improve economic strength and provide opportunities for all residents" (U.S. Dept. of Housing & Urban Development). In addition to the site visits, the team spent time reading local planning documents, history and formative landscape events, census data, and other literature about the region and the 5-counties to substantiate what was gathered in the field. In this way, the plan presents a broad, however cursory, understanding of existing conditions in the study area that is both qualitative and quantitative. A full list of issues and opportunities for each county are available as an appendix to the plan.

The next section of the plan prioritizes the issues and opportunities, leading to a set of goals for the region's sustainable development. The goals correlate to issues of housing, transportation, health, place identity, natural resources, rwesiliency, and economic development, including:

Recognizing that implementation occurs at

the local-level, the plan identifies measurable objectives as may apply to specific counties. It also describes the methods employed in the issue analysis and goal formation, of which some simulate public engagement strategies (e.g., facilitated brainstorming and key-pad polling). The value of these activities in terms of a democratic process is expressed in a brief section about public participation in planning. Thus, the team

developed a vision for the regional plan:

Sustainability as City and Region

To sustain a coastal community built on southern charm and tradition.

This vision summarizes the core intentions of the plan to serve Coastal Georgia's heritage, identity, and legacy.

Finally, the plan presents three scenarios designed to allow stakeholders to compare alternative future transportation, land use, and investment strategies to one defined by existing patterns and plans (i.e., "business as usual"), and recommends one that seems most likely to foster a sustainable land use development pattern for the coastal region's growing population. Each scenario expresses a different set of conditions and outcomes in keeping with the aspirations expressed in the vision and goals for the area as well as with the principle of sustainability. The methodology for modeling each scenario is explained and graphically illustrated.

Georgia Shrimper

The plan recommends a scenario in which the five counties of the study area intensely focus future development between the I-95 and US HWY 17 corridors. There are several reasons that make this scenario the most viable way forward. First, the 83 square mile swath is ideal for development because it is inland from sensitive wetlands and flood zones and it does not encroach upon the rural and agricultural character of the land west of I-95. Second, its proximity to existing transportation and other urban infrastructure means that continued federal,

executive summary

Campus of Coastal College of Georgia

Smart Growth

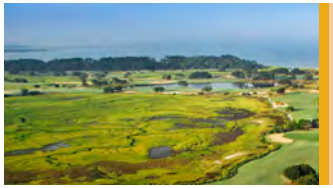
Jekyl Island Harbor

state, and local investment here will be cost-effective, and the growing population will naturally gravitate toward these resources.

Additionally, trends in public and private development indicate the value of density in urban planning, such as greater choice of housing and transportation options and healthy habits from walkability between activity centers (result of mixed land uses). The research on Smart Growth underscores the potential of the plan recommendation to outline a pattern of growth that attempts to reconcile the interests of conservation and economic development.

The plan concludes with a sober yet hopeful outlook for the region. It acknowledges the limitations of its findings and recommendations, and calls for further research in order to develop scenarios at the city and site levels and address more of the issues and opportunities raised in the study, such as housing, bike-

Marshes of St. Simons, Georgia



Downtown Brunswick, GA

pedestrian facilities, mixed land use and local identity. The faculty and student planning team endeavor to advance planning education and practice through continued cooperation with Coastal Georgia.

PALACE SALOON
DRINK
Coca-Cola

01 regional planning

coastal survey

The regional survey allows the project team to speak with people in the region, to gather information through interviews and site visits, in order to begin an iterative process that will guide and establish a plan for the region. The project team had three days, February 6–8, 2014, to visit the five-county study area in Coastal Georgia. There, the team met with planning agency staff and other county and municipal officials to gain insight into the conditions, issues, and opportunities. Additionally, the team gathered first-hand impressions of existing development types and patterns, local attractions, and the natural environment.

coastal survey

Figure 1. Map of Regional Project Study Area

In addition to the site visits, the team spent time reading existing planning documents, local history and formative landscape events, census data, and other literature about the region and the 5-counties to compare and contrast what was gathered in the field. In this way, the team developed a broad, however cursory, understanding of existing conditions in the study area that was both qualitative and quantitative.

The five counties that establish the study area include Bryan, Camden, Glynn, Liberty, and McIntosh counties. The combined land area is approximately 3,000 square miles (see Table 1), of which approximately 550 square miles are water bodies, such as tidal marshes, bays, lagoons, rivers, lakes, reservoirs, and swamps. Within these counties are 14 small cities and unincorporated communities. Larger cities lie just north and south of the study area,

CSX railline near St. Marys, GA

including the City of Savannah and the City of Jacksonville, Florida.

Two military bases and one port located in the study area, fueling the region's economy. A major interstate, I-95, connects all the counties with the rest of the US coast, while HWY 17 connects many of the regions cities along the coast. The area is also connected to a rail network, with service from CSX, Norfolk Southern, and Georgia Central, used mainly for transporting freight (McIntosh County is the only one not connected by rail). A unique feature of the area is its barrier islands (such as Cumberland Island National Seashore), tidal marshes, and intracoastal waterway. Over 25% of the area is water (see Table 1), and soil conditions in the Coastal Region are generally considered unsuitable for development because of poor drainage (GA DCA, 2005). Thus, a challenge to future growth and development in this area is the significant percentage of land that is wetlands and/or subject to regular flooding and erosion.

The region is rich in history. Many human societies are known to have settled here, including Native Americans, Spanish, English, and the nationalities represented by waves of immigrants and

Table 1. Land and Water Characteristics

County	Area (sq. miles)	Land (sq. miles)	Water (sq. miles)	County Seat
Bryan	454.49	441.71	12.78	Pembroke
Camden	782.52	629.91	152.61	Woodbine
Glynn	585.17	422.37	162.80	Brunswick
Liberty	602.52	519.05	83.47	Hinesville
McIntosh	574.53	433.45	141.08	Darien
Total:	2,999.23	2,446.49	552.74	

coastal survey

slaves. The economies, conflicts, natural forces and other factors have shaped settlement patterns, and contributed to the area's unique look, feel, taste, and general southern-coastal aesthetic.

In terms of its population, the region is growing. It experienced approximately 2% growth in population on average from 2000-2012 (US Census), and further growth is expected in the next decade. Currently, the total population is approximately 250,000 people. Table 2 indicates the spread of people across the study area, with the largest concentration being in Glynn County. Though Liberty County has the second largest population (closest to Savannah), it has the slowest growth rate. The fastest

Table 2. Population Projections

County	Year 2000 Pop.	Year 2010 Pop.	Population Growth Rate % (2000 to 2010)	Estimated 2012 Pop.	Projected Year 2014 Pop.	Projected Year 2034 Pop.
(2000 to 2010)	23,417	30,233	2.59	32,214	34,322	-
Bryan	43,664	50,513	1.47	51,402	52,311	-
Camden	67,568	79,626	1.66	81,022	82,438	-
Glynn	61,610	63,453	0.30	65,471	67,556	-
Liberty	10,847	14,333	2.83	13,839	14,325	-
McIntosh	207,106	238,158	-	243,948	250,952	300,841

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ke up the smallest

educational attainment
ts over the age of 25
e-counties, the largest
87%) has some college
or an Associate's

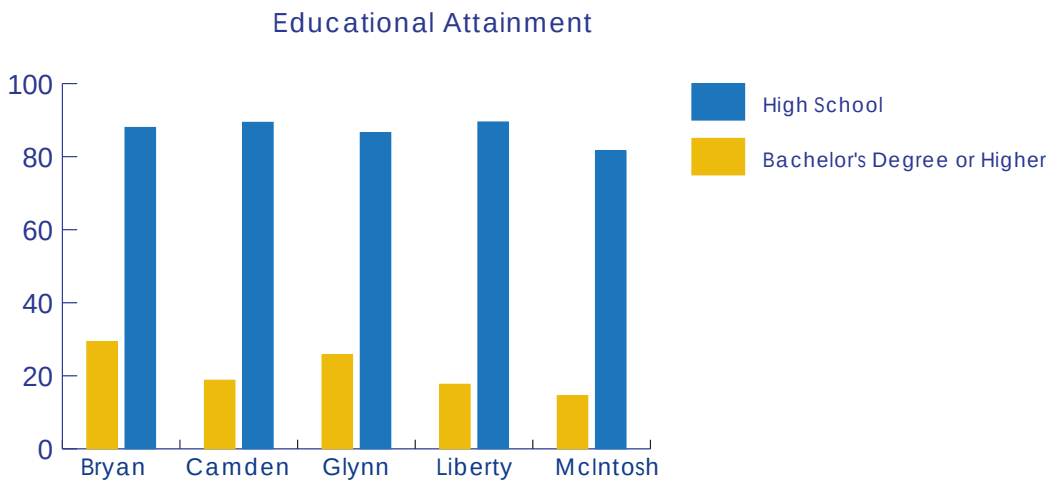
degree. This is slightly higher than the State of Georgia average, 84.4%. The percentage of residents who have attained a Bachelor's degree or higher, 21.3%, is slightly lower than the State average, 27.8%.

Schools in the Coastal Region of Georgia are overcrowded due to the amount of growth that the region has seen (GA DCA, 2005). Several institutes of higher education are located within the region: Armstrong Atlantic State University, College of Coastal Georgia, Georgia Southern University, Savannah College of Art and Design, College of Coastal Georgia, and Savannah State University (CRC, 2014 Economic). The coastal region is being well served by these

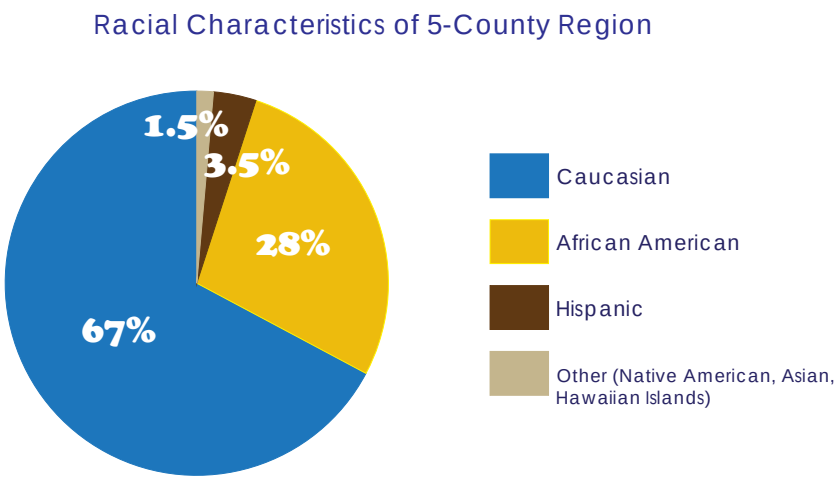
Table 3. Household Data

County	Year 2000 Households	Year 2010 Households	Households Growth Rate (2000 to 2010)	Median Household Income (2008-2012)
Bryan	8,089	10,738	2.87%	$63,818
Camden	14,705	18,047	2.07%	$54,155
Glynn	27,208	31,774	1.56%	$49,986
Liberty	19,383	22,155	1.35%	$44,295
McIntosh	4,202	5,971	3.58%	$39,506
Total:	73,587	88,685	2.29%	-

coastal survey



of 237,940 persons. Furthermore, the median age across the study area is 36, indicating that half of the population is under 36 and the other half is over 36. The factors which could increase this number in coming years include greater life expectancy, a general trend of retirees moving south, and young people leaving the area for better education and/or employment opportunities. This would have implications for the area's consumer consumption, productivity, and growth strategies (need for exports). The Coastal Regional Commission facilitates institutions; however, there are still needs in certain communities, such as McIntosh County, for greater accessibility to the programs and services that these institutions provide. The need for more educational infrastructure and resources within the region will continue to grow as the population increases.



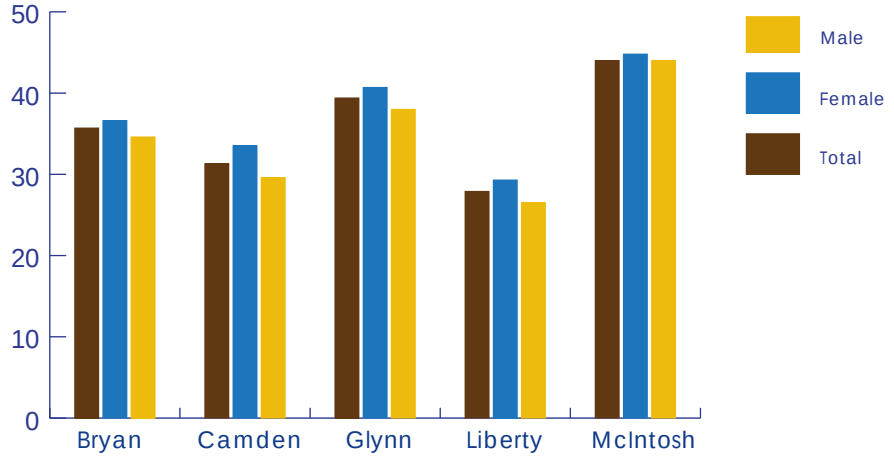
The U.S. Census Bureau data estimates for the year 2010 indicate that residents in the study area are predominately "white," with 154,326 persons classified as white in a total population

special services for the aging population in the region, and planning that considers the needs of this growing demographic will be important going forward (CRC, 2014 Economic).

The region does not have a designated hospital or health center. However, Southeast Georgia Health System, a not-for-profit healthcare system, has campuses in Brunswick (Glynn County) and St. Mary's (Camden County). They also have offices in St. Simon's Island, Brantley, and Darien. These facilities offer special services in senior care, cancer care, orthopedics, and spine care (SE GA Health System, 2014). These healthcare providers work with institutes of higher education, such as the radiology department at the College of Coastal Georgia, to further serve the community's health care needs.

The labor force statistics in Table 4, combined with the population data in Table 2, suggest that roughly half of the total population make up the area's human resources, and the great majority of employment opportunities are in the civilian sector. The numbers of armed forces employees are greatest in Camden County and Liberty County, where there are military installations (Ft. Stuart and Kings Bay). The numbers of unemployed civilian labor likely reflect the poor economic conditions of the time the data were collected; however, they also suggest that the need for additional employment opportunities is consistent across all five counties in the study area.

Median Age of 5-County Area



coastal survey

Smart Gro

Dominant industry sectors in the area include retail trade, transportation and warehousing, professional scientific and technical services, arts entertainment and recreation, accommodation and food services, and other (non-public) services. Other industry types in the study area include: agriculture, forestry, fishing and hunting, utilities, construction, manufacturing, wholesale trade, information, finance and insurance, real estate and rental and leasing, management of companies and enterprises, administrative and support services, waste management and remediation services, educational services, health care and social assistance.

Table 4. Labor Characteristics

County	Labor Force	Civilian Labor, Employed	Civilian Labor, Unemployed	Armed Forces
Bryan	15,802	85.5%	8.5%	6%
Camden	25,735	77.1%	8.7%	14.2%
Glynn	40,165	89.3%	10.5%	.2%
Liberty	32,546	69.9%	9.4%	20.7%
McIntosh	6,223	89.3%	10.7%	0%
Total:	120,471			

The Port of Brunswick (Glynn County) acts as a major economic driver for the study area. Being both sizeable and stable, the port offers high-paying jobs and serves area industries. On the other hand, the dredging required for upkeep of the port raises concerns about environmental consequences

Health Commun

survey

(CRC, 2014 Economic). Brunswick is home to Glynco Airport, which offers service to Atlanta from Atlantic Southeast Airlines (GA DCA, 2005). The region also has easy access to nearby international airports in Savannah, GA and Jacksonville, FL.

Relative to the discussion of employment characteristics is the average work commute in the study area: 22 minutes. This is primarily workers who drive alone (vs. transit or carpool), and locals reported relatively low incidents of congestion. A public transit alternative is only offered in Liberty County at present, and a rural public transportation service is operated by the Coastal Regional Commission. The CRC program also provides a vanpool service that primarily serves rural residents.

There are bike lanes and bike-pedestrian paths cropping up across the study area, but connectivity between vital activity centers (e.g., housing, jobs, shopping, recreation, entertainment) is not evident in most cases; furthermore, where bike lanes and sidewalks exist, they are often not grade-separated or green-separated from vehicle traffic, which would make them safer and induce greater utilization.

One strength the region has in terms of economic growth potential is that, for a coastal area, its barrier island complex and shoreline contour make the region less prone to hurricanes than many other coastal regions (GA DCA, 2005). More than half of the barrier islands are publicly owned and, except for Jekyll Island in Glynn County, none of the publicly owned islands are accessible by car from the mainland. These pristine islands are relatively undisturbed and serve

coastal survey

2005). Tourism is a significant part of the coastal economy.

Development here can generally be described as low-density, given the area's physical footprint (Table 1) and its household statistics (Table 3). The team found that urban services (water, sewer) were provided only in the cities and along the coast where permitted, and that the "interior," non-coastal areas were rural-agricultural in character (west of I-95 with few exceptions). The following images provide a sample of city densities in the study area.

Photo 1: Density in Kingston, Camden County

This first image is of an area in Kingston that is approximately 44 acres with approximately 75 houses, a park, and water tower facilities. The relative density is 1.7 DU.

survey

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public participation plan

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Public participation is essential to developing, implementing, and improving long-range plans that will provide meaningful and effective guidance for future well-being of the communities that the plans serve. The extent of participation by the community can be a key factor in determining whether a plan gets implemented and the desired outcomes are realized. In light of existing federal, state, and local provisions that require some form of public participation in public decision-making, it is necessary to develop a public participation plan and to document the engagement activities that drive the resulting plan.

It is vital for a community's citizens to not only participate in decision-making--especially in areas which may bear direct impact on their quality of life--but also to monitor the implementation and outcomes of these decisions to provide valuable feedback. Leadership and dedication to the process will be required for successful public participation in planning, and the process will go through multiple iterations before a plan reaches elected officials, who ultimately have the authority to adopt a proposed plan. The purpose of this document is to provide a framework and set of strategies for public participation toward a meaningful and effective regional plan.

As communities grow and expand, federal, state, and local provisions recognize the importance of regional planning in order to create livable communities that are also sustainable for future generations. Given the economic, social, and environmental complexities that make up a region, it is vital that citizens take part in formulating the vision and plan that will guide

public decision-making in their community as well as in the region. The following questions should be considered when developing a public participation strategy.

Who are the "public" participants?

The public participation element of the regional planning process should be open to the people with an interest and a stake in the future of the region and its communities. There are many people that fit that definition. Figure 2 provides a general blanket of potential stakeholders that fit the target "public" audience to invite to the table.

What does "public participation" mean in planning?

Public participation is a fundamental process in realizing the vision for a community's future. This vision represents the collective "voice" of every citizen, expresses the

Targeted Stakeholders

- Local residents, including historically under-represented communities
- Community leaders
- Chambers of Commerce, business owners, development authorities, developers
- Neighborhood associations
- Government agencies
- Non-profit organizations
- Convention and Visitors Bureaus
- Historic preservationists, Cultural authorities
- Naturalists, conservationists, outdoor enthusiasts

desired outcomes of a community plan, and leads to the creation of its goals and objectives. Arriving at a preferred scenario that informs a community's plan is incumbent upon active public participation, particularly if the plan is to sustain legitimacy and relevance to the community in the long range.

How can the public participate in planning?

To employ a collaborative approach to the comprehensive plan, it's critical to establish a process whereby communities can openly and productively engage with one another around issues they deem important. Because this is a creative and "messy" process, innovative strategies are often utilized that not only provide opportunities for inter-active public participation, but that also support a fair and open process to invite and represent the voice of everyone engaged in the regional plan. Figure 3 lists possible strategies for marketing, education, decision support, and citizen input.

The leadership meeting serves to establish consensus on the need for public participation in planning, strategies for communicating to the public about opportunities to participate, define target stakeholders across the jurisdictions involved, inventory assets that each leader's community can lend to the effort (e.g. staff, technology, meeting space, funding), and identify dates and locations for public

Marketing and Education/Awareness Strategies

mailings
newsletters
news releases
community calendar
project web site
print advertisements
displays and exhibits

Decision Support Strategies

local community official meetings
referenda
interactive GIS
cluster workshops - round table
citizen advisory committee (ad hoc)

Input Strategies

small group or focus meetings
property owner meetings
opinon surveys
Key Pad polling
visual preference surveys
cognitive mapping/visioning

meetings.

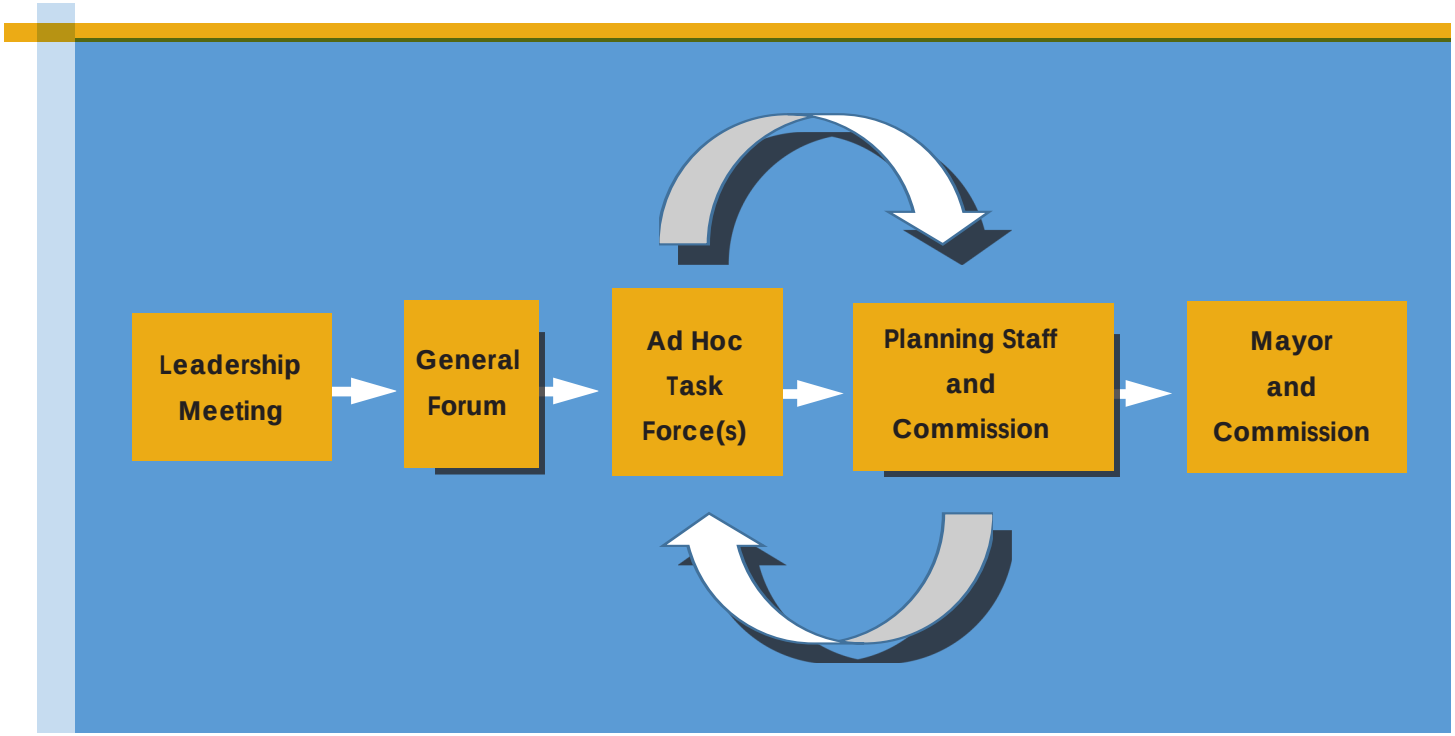
The general forum provides an opportunity for the public to provide input on community issues, existing conditions, and develop a vision for a regional plan. This forum will invite interested person to continue in the planning process by participation in ad hoc task forces

Ad hoc task forces meet regularly and are organized around specific issues. They are designed to provide recommendations on county objectives stemming from regional goals. Recommendations will be shared with the planning staff and commission.

In turn, the planning staff and commission evaluate the recommendations of the ad hoc committee to develop a draft regional plan. The draft plan is taken back to the tasks forces for feedback and suggestions for improvement. The final agreed upon plan is then presented to the mayor and commission.

survey

The arrows in the Figure 3 illustrate a linear process as well as a circular process, because the definition of goals and objectives will be iterative in nature to accommodate multiple stakeholders as well as feasibility and other practical considerations. The plan will develop in phases/ stages which will repeat as necessary.



Finally, it is critical to post results of participation activities in a report to local officials and for public consumption (e.g., on-line, newspaper, pamphlet). The final report should indicate a clear vision, goals and objectives, with a schedule of targets for completing specific milestones. Key actions should be assigned to specific organizations, agencies or individuals, so that it is clear who is responsible for what. These communications should be developed to be easily understood by a broad audience with multiple visual elements.

When & Where does public participation happen?

To conduct an effective public participation effort,

it is important to consider locations, dates, and times that will accommodate the greatest participation across the targeted stakeholders. This may mean that multiple events at multiple locations will be necessary. For example, you may host the large initial meetings during the

week at lunch time and in the evening, as well as a weekend session, and these will be duplicated across all the communities involved in the plan. As the program moves to task forces, these smaller groups can schedule meeting times and locations that work for them.

Public participation is an essential ingredient to a meaningful and effective long-range planning for future well-being of the communities that the plan serves. Federal, state, and local provisions require some form o m

Plan Phases

Pre-Planning: Develop leadership, process & design

Stage 1: Data collection & analysis of existing conditions

Stage 2: Visioning & issue identification

Stage 3: Goals & objectives formulation

Stage 4: Scenarios & strategy formulation

Stage 5: Plan review & approval & adoption

Post Planning: Implementation, monitoring & assessment

GEORGIA BULLDOGS

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03 equitable h health

issues & opportunities

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The input gathered from the site visit to the five-county study area of Coastal Georgia, as reflected in the regional survey report, provides a broad array of issues and opportunities for this area. Given resource constraints for program initiatives, the challenge is to prioritize the issues and opportunities in order of importance to the community, while considering current levels of service, to ultimately identify the issues and opportunities that deserve immediate attention. One tool that is useful to this task is the SWOT (Strengths, Weaknesses, Opportunities, and Threats) Analysis.

issues & opportunities

Using the SWOT Analysis method, the team organized the issues and opportunities by operational area (e.g., Transportation, Housing, Natural Resources, Economic Development), weighted/prioritized the issues in order of perceived importance to the communities, and ranked the perceived levels of service across all issues. In this way, the SWOT Analysis scores each issue using both quantitative and qualitative measures. A negative score indicates those issues that should be addressed first, because it means the issue is important to the community but at a low level of service at present (or perhaps not being served at all).

Additionally, the SWOT Analysis distinguishes between internal and external factors that directly or indirectly impact a community's physical, social, economic, and political environments. Internal factors for this type of analysis are considered to be strengths and weaknesses, while the external factors are considered to be opportunities and threats. Thus, the analysis can be used to align the study area's internal strengths with the external opportunities, while at the same time identifying weaknesses to be addressed in order to avoid potential threats.

Figure 5 in the Appendix captures the factors of the SWOT analysis. The main topics of interest are highlighted in yellow, and under each of these is a subset of issues used to indicate strengths and weaknesses. Each of these issues has a weight or ranking of importance, as well as a qualitative, empirical measure of the current level of service. A simple scale of "favorable", "neutral", or "unfavorable" is used. The qualitative measures correlate to quantitative measures for the purpose of scoring. The score for each issue is a factor of the weight x rate. Here, the neutral (null) score is not an indicator of indifference about an issue, rather in many cases it indicates the issue

a coastal communit

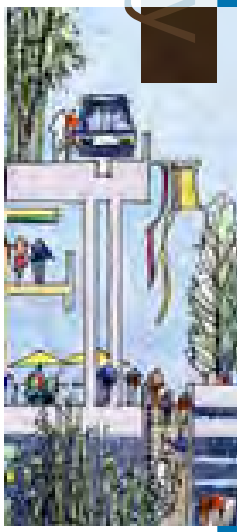
survey

Issues that score significantly high (over 3.5) include:

- Preservation/conservation of barrier islands (6)
- Affordable single, multi-family, and senio housing near jobs (5)
- Participation in regional planning (5)
- Planning tied to community vision (4)
- Agriculture (4)
- Aquaculture (4)

Issues that score significantly low (below -3.5) include:

- Connection between historic centers and new development (-7)
- Regional, cross-jurisdictional coopearation for economic development (-7)
- Educational outreach (-6)
- Walkability (-6)
- Biodiversity (-6)
- Green infrastructure (-4)



USE CONCRETE
SIDEWALKS
ON STAIRS
LAURENDALE

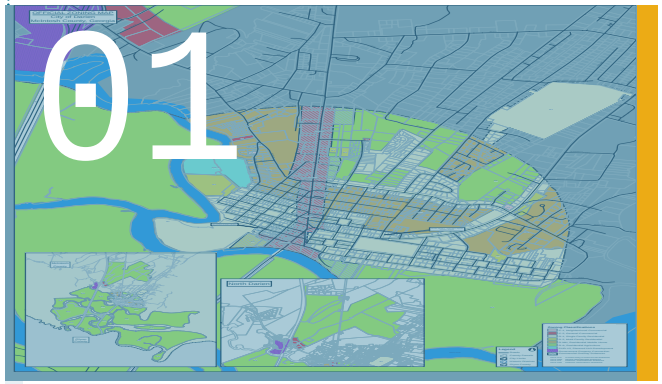
vision

goals & objectives

scenarios

VISIONING

coastal
georgia



01 vision

The team participated in a facilitated visioning exercise. Taking into account the survey of existing conditions in the region, the team generated multiple impressions—from a 30,000 foot perspective down to street-level perspectives—and visualized "ideal" futures for the region and for individual places across the study area. Through this exercise, several themes emerged, with the primary vision centering on a vital and vibrant future that incorporates the area's unique natural assets, attractions, values, and capacity for growth. Ultimately, the vision for the regional plan came to be:

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02 sustaina commun

goals & objectives

An important aspect of the planning process is to cycle back and revisit information, data, and decisions after each phase to be sure that the outcomes are satisfactory. The team was led in an exercise to develop goals and objectives. First, the team reflected upon the issues that scored the highest and lowest in the identification of strengths, weaknesses, opportunities and threats. This way, the team considered both the issues that are desired but difficult to achieve if nothing is done as well as the issues that are undesirable and will happen easily if nothing is done.

goals & objectives

Ensure equitable housing choices
Reduce vehicle miles traveled
Enhance transportation network to promote regional assets
Promote healthy communities by increasing non-motorized transportation choices
Develop regional identity
Support local identity
Build healthy communities in the region
Facilitate biodiversity in the region
Adopt binding policy to protect watersheds in the region
Design an urban service boundary to minimize development sprawl
Strive for more flood resilient communities
Foster regional economic development strategies
Increase employment levels and employment opportunities across the region

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goals & objectives

GOAL: Maintain and enhance regional biodiversity.

Objectives:

Camden County
Improve areas of overlap between generalized locations of federal or state designated threatened and endangered species and potential conservation areas as described by DNR's wildlife strategy.
Bryan County
Improve and maintain regional comprehensive inventory of natural resources and map.
Establishm "no development" zones to protect the region's natural and cultural resources.
Develop and adopt a sustainable tree plans and ordinances.
Liberty County
Increase public awareness about the importance of wetland and barrier island conservation within Liberty County.
McIntosh County
Preserve rural natural character and vistas outside planned urban service areas.
Encourage the preservation of open spaces including, for example, natural and agricultural areas in conservation subdivisions as part of future development proposals in the County.
Guide urban land uses to land that can sustain urban development.
GOAL: Protect river corridors and watersheds in the region from degradation caused by development.

Objectives:

Camden County
Increase river buffer from 100 ft to 250 ft, as recommended in the Greenprint for Camden County model goals (The Trust, 2008)
Increase limitations of industrial and commercial development within river corridor protection area and watersheds by 2020 (Camden County, May 2009).
Strategy: Enact a time limitation on exemption granted to industrial and commercial land uses existing prior to river corridor protection ordinance
Strategy: Develop alternate water supply program such as a purple pipe water supply (e.g. Liberty County) for industrial and commercial enterprise needs so they can locate outside of the river corridor protection areas.
Bryan County
Enhance state buffer zone ordinances around rivers,creeks and lakes for site development to protect water supply and
ensure water quality and preserve wildlife habitat.
McIntosh County
Reduce sedimentation, pollution, and eutrophication of lakes, rivers, and streams in McIntosh County.
Reduce reliance on groundwater resources for water supply in McIntosh County.

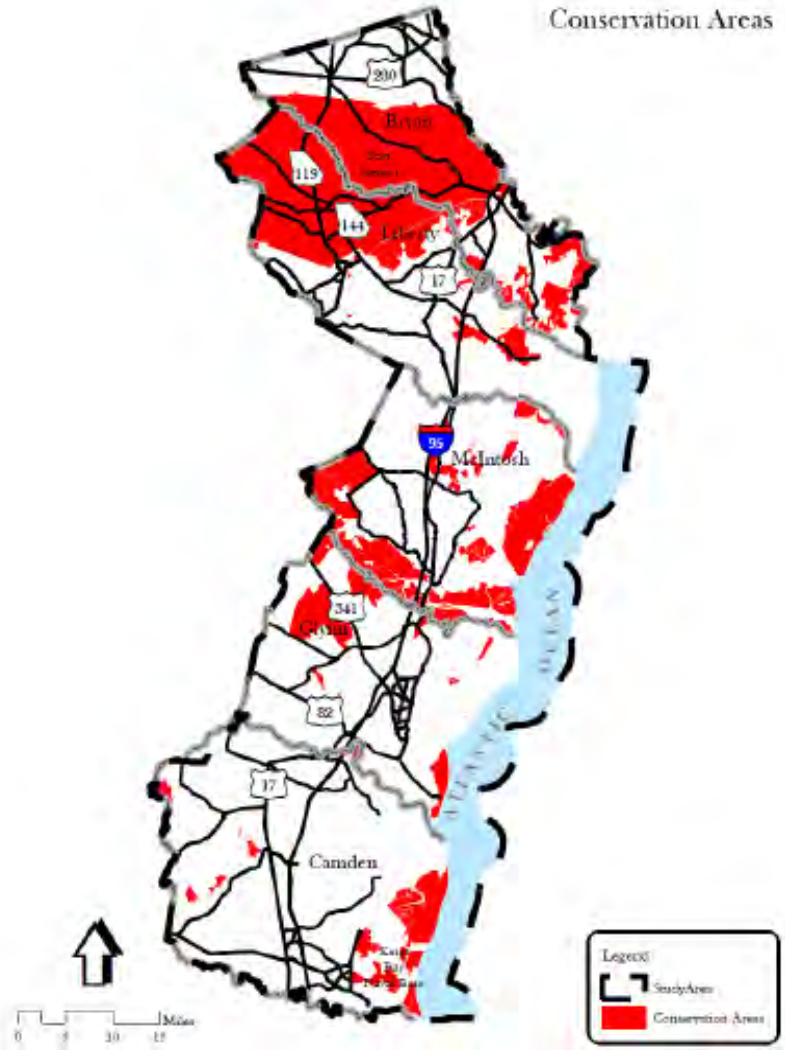
Corner Cafe

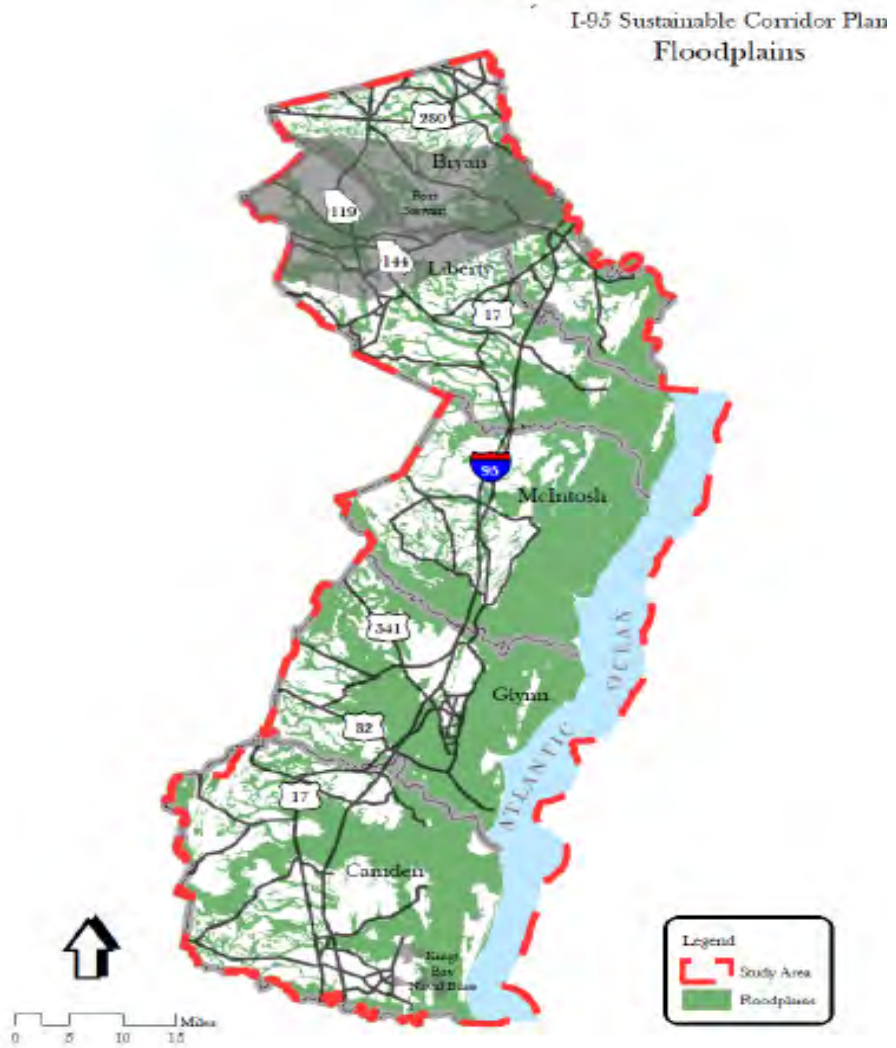
goals & objectives

goals & objectives

I-95 Sustainable Corridor Plan

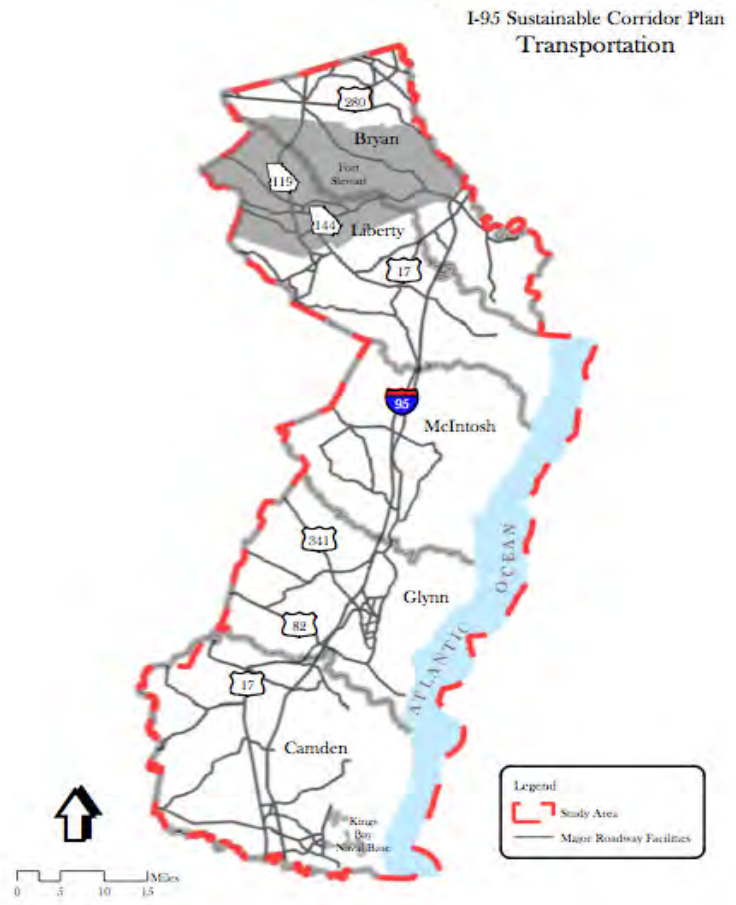
Conservation Areas



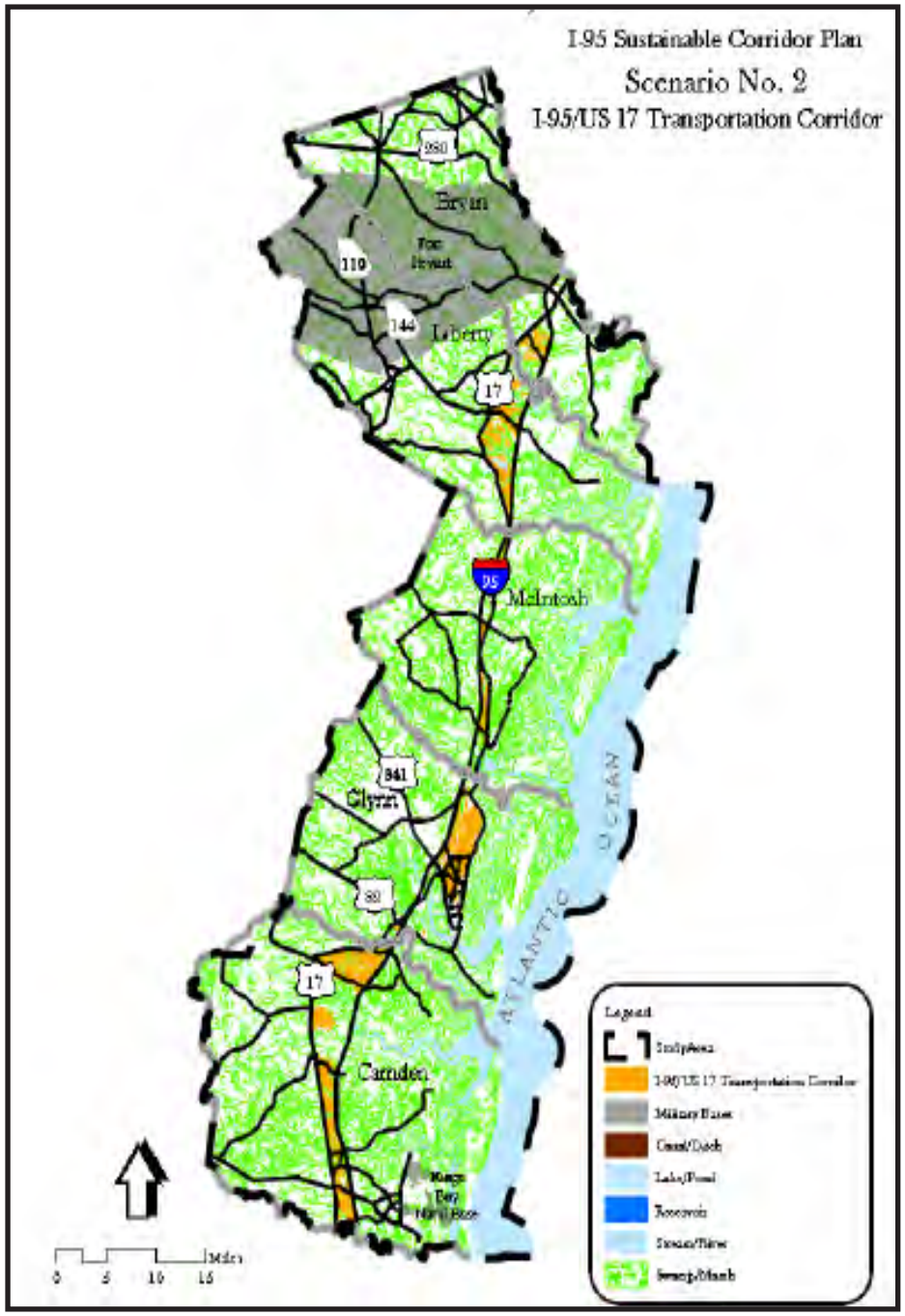

I-95 Sustainable Corridor Plan
Floodplains
280
Bryan
119
144
Liberty
17
95
McIntosh
341
Glynn
82
17
Camden
ATLANTIC OCEAN
Legend
Study Area
Floodplains
Miles
0
5
10
15

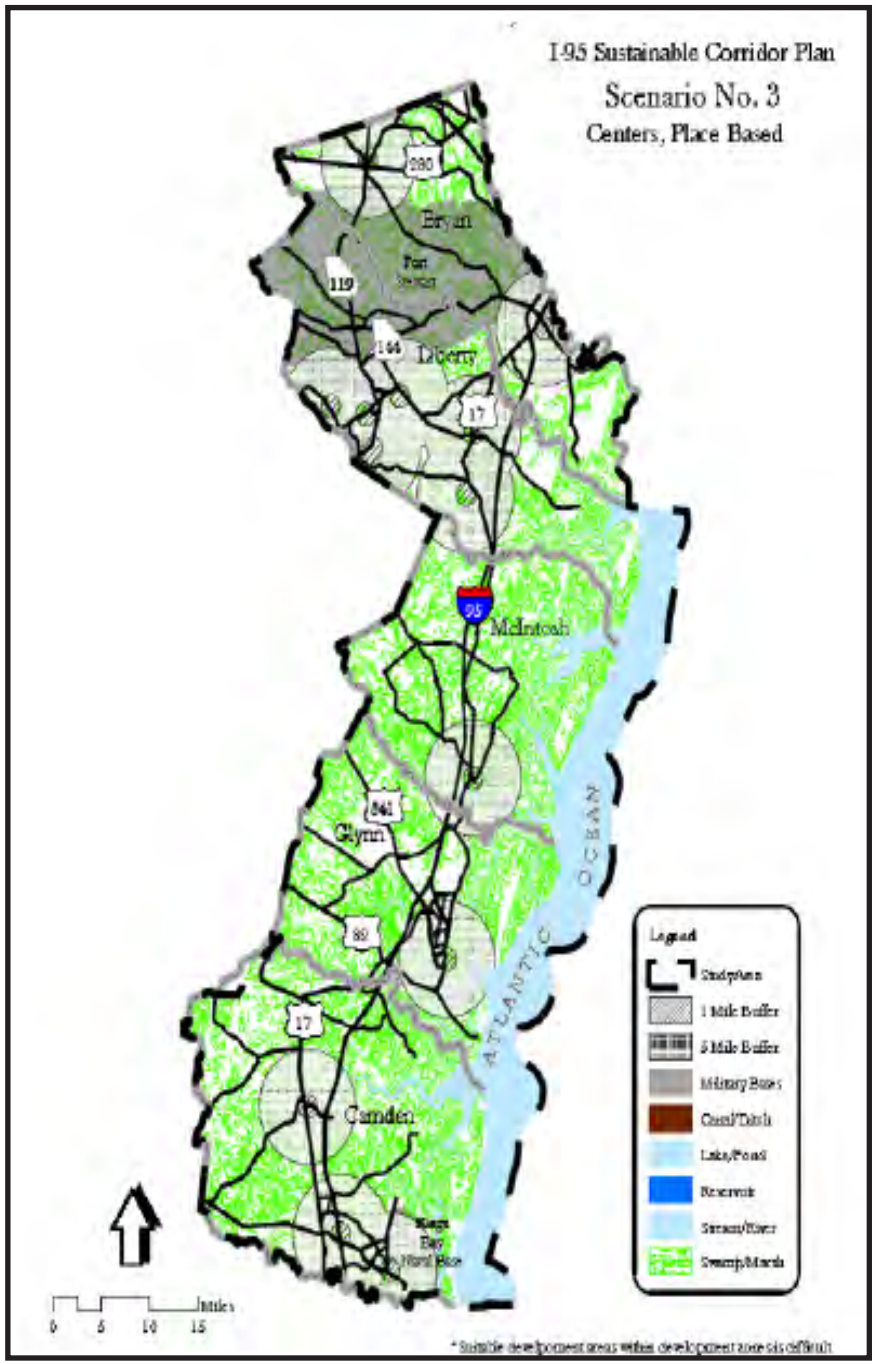
I-95 Sustainable Corridor Plan
Hydrology

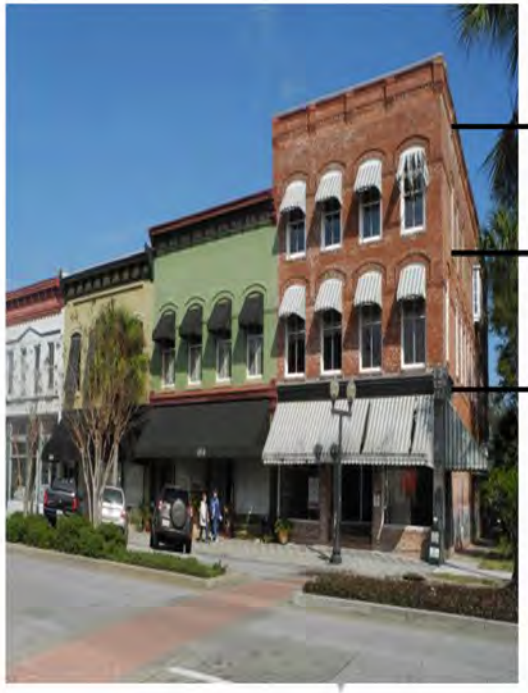
I-95 Sustainable Corridor Plan
Wetlands

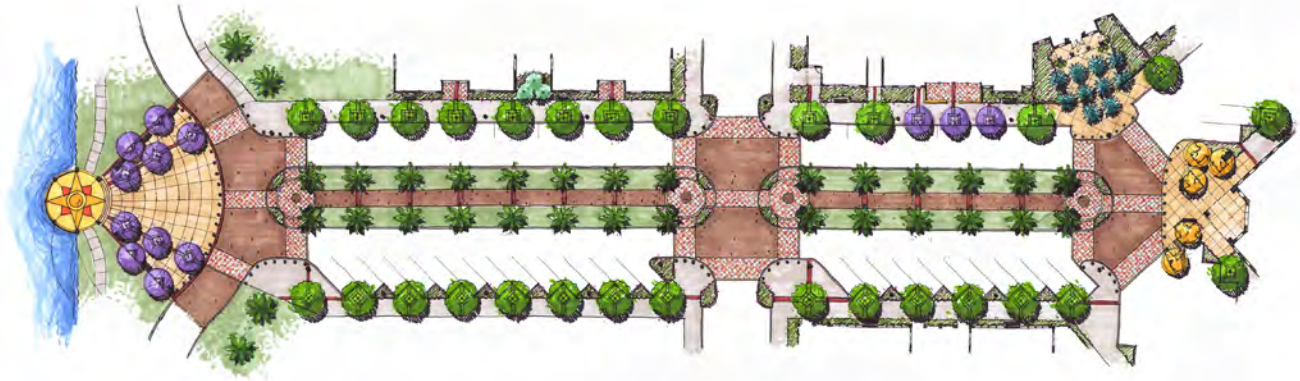

I-95 Sustainable Corridor Plan
Transportation
280
Bryan
Fort Stewart
119
144
Liberty
17
95
McIntosh
341
Glynn
82
17
Camden
ATLANTIC OCEAN
Legend
Study Area
Major Roadway Facilities
Miles
0 5 10 15

I-95 Sustainable Corridor Plan
Municipalities
Pembroke
Bryan
Richmond Hill
Liberty
Flemington
Gumbranch
Hinesville
Allenhurst
Midway
Walthourville
Riceboro
McIntosh
Darien
Glynn
Brunswick
ATLANTIC OCEAN
Woodbine
Camden
Kingsland
St. Marys
Legend
Municipalities
Study Area
0 5 10 15 Miles


I-95 Sustainable Corridor Plan
Scenario No. 2
I-95/US 17 Transportation Corridor
Bryan
Fort Stewart
Liberty
McIntosh
Glynn
Camden
ATLANTIC OCEAN
Legend
Study Area
I-95/US 17 Transportation Corridor
Military Bases
Canal/Ditch
Lake/Pond
Reservoir
Stream/River
Swamp/Marsh
Miles
0 5 10 15


I-95 Sustainable Corridor Plan
Scenario No. 3
Centers, Place Based
Bryan
Fort Stewart
Liberty
McIntosh
Glynn
Camden
ATLANTIC OCEAN
Legend
Study Area
1 Mile Buffer
5 Mile Buffer
Military Bases
Canal/Ditch
Lake/Pond
Reservoir
Stream/River
Swamp/Marsh
Miles
0 5 10 15
* Suitable development areas within development zone are difficult


third floor - residential
second floor - office
ground floor - retail



Housing	Weight	Quant. Rate	Qual. Rate	Score
Affordable single, multi-family, and senior housing near jobs	5.0	1	Favorable	5.0
Infill development and multi-use encouraged	3.0	0	Neutral	0.0
Substandard/Vacant housing at low levels	1.0	-1	Unfavorable	-1.0
Total:	9.0	-		
Public Awareness	Weight	Quant. Rate	Qual. Rate	Score
Educational Outreach	6.0	-1	Unfavorable	-6.0
Public Engagement in Planning	0.0	1	Favorable	0.0
Total:	6.0	-	-	
Transportation	Weight	Quant. Rate	Qual. Rate	Score
Safe streets for bikes/pedestrians	5.0	0	Neutral	0.0
Transit	2.0	0	Neutral	0.0
Intracoastal waterway ferry	1.0	-1	Unfavorable	-1.0
Total:	8.0	-	-	
Demographics	Weight	Quant. Rate	Qual. Rate	Score
Income diversity in inland and coastal areas	3.0	0	Neutral	0.0
Balance of seasonal vs. year-round residents	1.0	1	Favorable	1.0
Replacement for aging population	1.0	0	Neutral	0.0
Established locals inclusive of new comers	1.0	0	Neutral	0.0
School site selection follows plan	1.0	-1	Unfavorable	-1.0
Crime-law enforcement plans and solutions	1.0	0	Neutral	0.0
Educational attainment fits job market	1.0	0	Neutral	0.0
Total:	9.0	-		
Place	Weight	Quant. Rate	Qual Rate	Score
Connection between historic centers and new development	7.0	-1	Unfavorable	7.0
Abundance of cultural resources	3.0	1	Favorable	3.0
Recreation/Open space	3.0	1	Favorable	3.0
Downtown vitality	2.0	-1	Unfavorable	-2.0
Historic preservation	2.0	1	Favorable	2.0
Infrastructure does not detract from sense of place	1.0	0	Neutral	0.0
Gateways identify communities	1.0	-1	Unfavorable	1.0
Total:	19.0	-	-	
Health	Weight	Quant. Rate	Qual. Rate	Score
Healthy communities are a priority	4.0	0	Neutral	0.0
Walkability	6.0	-1	Unfavorable	-6.0
Total:	10.0	-		
Planning & Policy	Weight	Quant. Rate	Qual. Rate	Score
Adoption and implementation of sustainable growth practices	3.0	0	Neutral	0.0
Participation in regional planning	5.0	1	Favorable	5.0
Planning tied to community's vision	4.0	1	Favorable	4.0
Uniform planning and design guidelines	2.0	-1	Unfavorable	-2.0
Addressing failing commercial corridors	2.0	-1	Unfavorable	-2.0
Limited spot zoning	2.0	0	Neutral	0.0
Comprehensive plans include target completion dates	2.0	0	Neutral	0.0
Adequate sign ordinances	1.0	-1	Unfavorable	-1.0
Use of GIS in planning	1.0	0	Neutral	0.0
Intergovernmental coordination and cooperation	0.0	-1	Unfavorable	0.0
Adequate planning staff	0.0	0	Neutral	0.0
Total:	22.0	-	-	
Natural Resources	Weight	Quant. Rate	Qual. Rate	Score
Preservation/Conservation of barrier Islands	6.0	1	Favorable	6.0
Preservation/Conservaiton of wetlands	3.0	0	Neutral	0.0
Biodiversity	6.0	-1	Unfavorable	-6.0
Agriculture	4.0	1	Favorable	4.0
Aquaculture	4.0	1	Favorable	4.0
Total:	23.0	-	-	
Water/Sewer	Weight	Quant. Rate	Qual. Rate	Score
Environmentally-sensitive flood zone mitigation	5.0	0	Neutral	0.0
Green infrastructure	4.0	-1	Unfavorable	-4.0
Adequate Water Quantity/Quality	3.0	0	Neutral	0.0
Agequate regional surface water treatment/attenuation standards	2.0	-1	Unfavorable	-2.0
Total:	14.0	-		
Economic Development	Weight	Quant. Rate	Qual. Rate	Score
Regional, cross-jurisdictional cooperation	7.0	-1	Unfavorable	-7.0
Diverse job base	6.0	0	Neutral	0.0
Coastal and Inland economic development	3.0	0	Neutral	0.0
Strong tourism industries	2.0	1	Favorable	2.0
Resilient to contracting brigades	2.0	-1	Unfavorable	-2.0
Military bases engaged in economic development plans	1.0	0	Neutral	0.0
Labor-ready workforce can transition to knowledge economy	1.0	-1	Unfavorable	-1.0
Funding for creative economic initiatives	1.0	-1	Unfavorable	-1.0
Air and Sea Ports engaged in economic development plans	1.0	0	Neutral	0.0
Diverse higher education opportunities in area (AA through PhD, and certificates)	0.0	0	Neutral	0.0
Total:	24.0	-	-	

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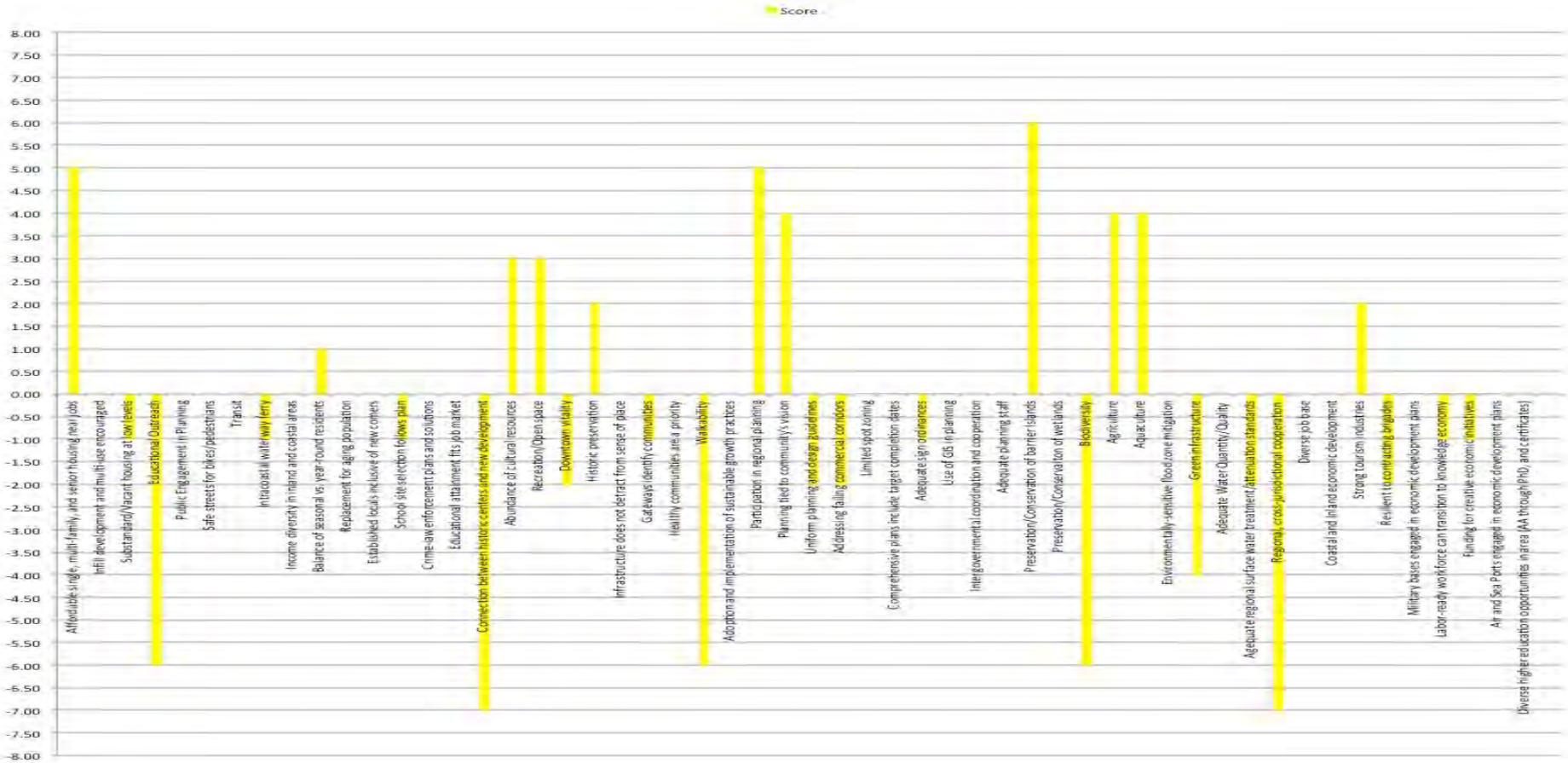
Score
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
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Substandard/Vacant housing at low levels
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Green infrastructure
Adequate Water Quantity/Quality
Adequate regional surface water treatment/attenuation standards
Regional, cross-jurisdictional cooperation
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Resilient to contracting brigades
Military bases engaged in economic development plans
Labor-ready workforce can transition to knowledge economy
Funding for creative economic initiatives
Air and Sea Ports engaged in economic development plans
Diverse higher education opportunities in area (AA through PhD, and certificates)

		Cost of Upfront Infrastructure		Cost of Services		Tax Revenue		
No. of Years	Municipality	Smart Growth	Conventional	Smart Growth	Conventional	Smart Growth	Conventional	Notes
1	Sarasota County FL	16,000/unit	20,000/unit	N/A	N/A	582,618/acre	7,795/acre	
1	Charlotte, NC	N/A	N/A	$159/capita	$740/capita	N/A	N/A	Fire Service Only

COMPREHENSIVE DEFINITION OF "RESILIENCE" IN URBAN PLANNING

By

SHRUTI AGRAWAL

(Under the direction of Prof. Umit Yilmaz)

ABSTRACT

Resiliency means the capacity of a system to absorb disturbance and re-organize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (Walker, et al. 2004). The notion of "Resilience" has evolved from the disciplines of materials science and environmental studies and is now used as an umbrella term for one of many planning and design strategies. But how do we define resilience in planning? Planning has many facets like urban growth, transportation, green infrastructure, and disaster response. How can resilience play a role in such a way that it encompasses all these factors? Considering the effects of climate change, it is crucial to understand the factors that define resiliency in planning especially for natural disasters.

The purpose of this practicum is to identify the factors that define "resilience" in urban planning. In order for a planning document to support resilience, it needs to focus on many factors including social, economics, and infrastructure issues. It is important to have a clear definition of these factors and the challenges they encompass, which will help us understand the term "resilience" well enough to address it accordingly. Eventually, we can successfully provide our cities with better opportunities to bounce back from any stressful natural event.The methodology for this practicum includes understanding the different areas of planning that consider resilience. This is achieved using articles, papers and case studies on

resilience planning and identifying different ways in which resilience and planning have been addressed in context to each other. The next step is to understand how resilience is actually related to planning. Once different applications of resilience are identified and documented, their applicability can be tested on the planning documents for coastal cities of Georgia.

The South Atlantic region of the United States consists of Virginia, North Carolina, South Carolina, Georgia and Florida. This region has survived many storm events and hurricanes very recently. These events stimulated the impacted areas to be prepared for further disasters and become more resilient in their planning. Due to the geographical location of Georgia (Georgia Bight), the state has managed to avoid these extreme hurricanes for past hundred years. A recent study was conducted as a University of Georgia studio project on coastal cities of Georgia showed that its low elevation is constantly making it susceptible to storm surge and sea level rise.

The research will help in creating a composite document for resilient coastal planning and its applications will be tested in Georgia by identifying the missing elements in local planning documents. These documents can then be updated by adding successful solutions adopted by the either neighboring counties or states.

Index words: Resilient planning, Matrix for resiliency, Demographic resilience, Infrastructure resiliency, Ecological resiliency, Socio-economic resiliency, Georgia resiliency index, Florida resiliency index.

COMPREHENSIVE DEFINITION OF "RESILIENCE" IN URBAN PLANNING

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1. INTRODUCTION

1.1 Project definition

What is Resiliency? And how can it be defined for cities? The dictionary defines resilience as "*the capacity of a system to absorb disturbance and re-organize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks"* (Walker, et al. 2004). But the real issues are the factors and considerations that would make a city resilient against the natural disaster. Due to absence of a comprehensive document that would include most of these issues in our cities, it is difficult to update or measure the resilience of a particular city in case of a natural event. **Thus, this practicum is about developing a comprehensive definition of "resiliency" in urban planning**. In the field of planning the term resiliency is used in many contexts, like demographic resiliency, socioeconomic resiliency, resiliency of the built environment, and environmental resiliency. As resiliency is an umbrella term used in different fields, it is important to understand the issues that are addressed by each of these factors, so as to correctly address them in a planning document.

To be specific, this research is focused on defining resiliency for storm surge, hurricanes and sea level rise for coastal cities. The applicability of the research would be tested on the planning documents of Savannah at coastal region of Georgia. Moreover, a list of planning solutions will be identified, which can be used to update the missing portions of the document.

1.2 Definitions of frequently used terms

a) **City:** City is a complex system of human settlement and facilities provided for them like sanitation, transportation, land-use, housing and many more (Paul James 2013). Although there is now a fixed number of population defining the city but according to US census bureau for Georgia, a city is defined as *"where the total population must be ≥ 200, and the population density must be ≥ 200 people per square mile, whereas for Florida minimum population for cities in counties with <50,000 residence, total population should be at least 1,500 residence and in other counties at least 5000 residence such that the population density of the place is ≥ 1.5 people per acre"*.

b) **Coastal Cities:** Cities located on the coast line with interface or transition between land and sea. These cities are diverse in form and are not defined by exact spatial boundaries.

c) **Disaster:** An event when a human system or an urban system intersects with the natural events (Smet, Lagadec and Leysen 2012, 138)

d) **Hurricane:** It is a type of a tropical cyclone with an intense tropical weather system and a well-defined circulation and maximum sustained winds of 74 mph (64 knots) or higher (NOAA). The 5 categories of hurricane are:

Category 1: Winds range from 74 to 95 mph and can be expected to product some minor damage to property.

Category 2: Winds range from 96 to 110 mph and can be expected to product extensive property damage.

Category 3: Winds ranging from 111 to 130 mph cause significant damage to property, humans, and animals.

Category 4: Winds range from 131 to 155 mph and can cause catastrophic damage to property, humans, and animals.

Category 5: Winds at or greater than 155 mph cause catastrophic damage to property, humans, and animals.

e) **Natural Disaster:** Natural disaster is defined as a natural event such as flood, earthquake, or hurricane that causes disturbance in urban setting.

f) **Storm surge:** Storm surge is an abnormal rise of water generated by a storm, over and above the predicted astronomical tides. This rise in water level can cause extreme flooding in coastal areas particularly when storm surge coincides with normal high tide, resulting in storm tides reaching up to 20 feet or more in some cases (NOAA).

g) **Sea-level rise:** The two major causes of global sea-level rise are thermal expansion caused by the warming of the oceans (expansion of water as it warms up) and the loss of land-based ice (glaciers and polar ice caps) due to increased melting. Records and research show that the sea level has been steadily rising at a rate of 0.04 to 0.1 inches per year since 1900. Since 1992, new methods of satellite altimetry (the measurement of elevation or altitude) indicate a rate of rise of 0.12 inches per year.

1.3 Why Coastal cities of Georgia?

Coastal Georgia presents a socially diverse and ecologically important region within the Southeastern United States. Like many coastal regions, sea level rise and hurricanes present a

prevailing threat to this developing coast. Georgia's low coastal elevation makes it extremely susceptible to the effects of sea level rise as predicted by NOAA and the Environmental Protection Agency. Also in past 10 years Georgia has been hit by 4 tropical storms Bonny (2004), Tammy (2005), Barry (2007), and recently Arthur (2014), causing further destruction by storm surge. The coast has been lucky in its avoidance of a major hurricane due to Georgia Bight, in over 100 years as reported by GEMA. But we cannot depend on luck for long in the near future. Planning for hurricanes, flood and sea level rise is critical for the coasts to not only be resilient, but also sustainable. After the Atlantic Hurricane Katrina (2005) that caused the failure of all the planning strategies, Florida has adopted and updated their policies for preparedness, response, recovery and mitigation to have more resilient cities. But Georgia continues to face the same challenges. Moreover, Georgia has approximately 378,000 acres of salt marsh, which is one-third of total marsh area on the eastern sea boarder, which needs to be protected by sound planning. Thus, in order to update the plans, the first step is to identify gaps in the planning documents of the coastal cities, and this research will provide a matrix for the same.

1.4 Methodology

The process of the research began with the question "How to define the term resilience?" Then came an understanding of the different factors associated with resilience (Includes the study of over 20 research papers related to resiliency in a city/urban area). The detail of the process is explained in chapter 2 of this document "Factors of resilience". This research lead to identification of 5 different factors which discuss resiliency - demography, urban infrastructure (physical and organizational infrastructure), ecosystem, and socioeconomic structures. Furthermore, a list of issues has been created to define each of these factors for

resiliency in city planning. The next step is the creating a matrix addressing all issues put together in such a way that can be incorporated in the planning documents of coastal cities.

Once the matrix is in place, the next step is to identify two cities one in each state of Georgia and Florida for suggesting planning recommendations. The cities that include most of the planning challenges in both states were selected. Thus, for selecting the city following data was considered for both Georgia and Florida:

1) Size of the city: **TIGER** Data (**T**opologically **I**ntegrated **G**eographic **E**ncoding and **R**eferencing).
2) Total population: United Stated Census Bureau
3) Past natural disaster events in the region: NOAA (National Oceanic and Atmospheric Administration) data for hurricane paths.

All three layers were then overlapped to see which city has topped in each of these sections. Cities with similar configuration in the state of Florida were also grouped together to find the appropriate recommendation for a city. Along with the above three layers, factors like tourism, port cities, and development in terms of infrastructure were also considered to select city.

Last section of the research is to check the applicability of the resilience matrix on the planning document of the selected city and find the missing sections of it, which could be completed using the implementations in the planning documents of similar cities in the state of Florida. This research aims to help the coastal regions to identify the missing sections of the planning documents of the cities and divert the critical funding and human resources to update that particular section.

2. FACTORS OF "RESILIENCE" IN URBAN PLANNING

2.1 Introduction

How can public policy help in disaster risk management in urban areas? Planning policies are created to reduce the vulnerability to the risk and to cope with the impact. Disaster risk management does not eliminated the risk from the natural event, but help in reducing the impact of the risk. Failure to be prepared for a risk could result in greater damage to assets and loss of human life. Along with this it can cause some serious damage to the economy of the place. Thus this practicum is to understand the preventive measures that can be adopted in planning documents to maintain the resiliency of an urban system against a natural disaster.

Availability of natural resources and mode of transportation increases the development around that place. This development includes the increase in population and economic center, and infrastructure. Of these areas, the once which are prone to frequent disturbance due to natural events, like coastal cities, it is important to plan before hand to reduce the impact of disturbance. Since the measurement of disaster impact depend on the land market, economic impact and social vulnerability of the area, it is important to understand the factors that define the resilience of these factors, which can be addressed in the policies for a better sustained future.

2.2 Research process

The research process adopted in this thesis is to understand the different areas in planning for which resilience had been defined, with referring to the ideas of resilience discussed by writers and scholars. Following are the list of articles reviewed for identifying those factors:

Table 2-1 Reference resources for identifying the factors of Resilience

Reference resource	Factor for resilience
1) Cutter, S. L., et al. (2009). "Social vulnerability to climate variability hazards: A review of the literature." Final Report to Oxfam America: 1-44.	Social vulnerability Demographics
2) Briguglio, Lino, et al. (2006). "Conceptualizing and measuring economic resilience." Building the economic resilience of small states: 265-88.	Economic vulnerability
3) * Rose, Adam. "Defining and measuring economic resilience to disasters. (2004). “Disaster Prevention and Management 13.4: 307-314	Economic vulnerability
4) Cavallo, E., et al. (2013). "CATASTROPHIC NATURAL DISASTERS AND ECONOMIC GROWTH." Review of Economics & Statistics 95(5): 1549-1561	Economic growth
5) Skidmore, M. and H. Toya (2013). "Natural Disaster Impacts and Fiscal Decentralization." Land Economics 89(1): 101-117.	Economic vulnerability
6) Husted, T. and D. Nickerson (2014). "Political Economy of	Resiliency in policies

Presidential Disaster Declarations and Federal Disaster Assistance." Public Finance Review 42(1): 35-57.	for post disaster recovery fund.
7) Tobin, G. A. (1999). "Sustainability and community resilience: the holy grail of hazards planning?" Global Environmental Change Part B: Environmental Hazards 1(1): 13-25.	Hazard planning
8) Gunderson, L. (2010). "Ecological and human community resilience in response to natural disasters." Ecology and Society 15(2): 18.	Ecological resiliency and Human community
9) Haimes, Y. Y. (2012). "Systems-Based Approach to Preparedness for, Response to, and Recovery from Natural and Human-Made	Awareness and preparedness.
10) Lall, Somik V., and Uwe Deichmann. (2009). Density and Disaster: Economics of Urban Hazard Risk Environment and Energy team. Policy Research Working Paper 5161, World Bank.	Demographics
11) Chang, S. E. (2003). "Evaluating disaster mitigations: methodology for urban infrastructure systems." Natural Hazards Review 4(4): 186-196.	Infrastructure
12) FEMA (2004). “Summary of coastal construction requirement and recommendations.” US department of homeland security: 1-8	Infrastructure
13) Jones, Christopher P., William L. Coulbourne, Jamie	Infrastructure

Marshall, and Spencer M. Rogers Jr. (2006). "Evaluation of the National Flood Insurance Program's building standards." American Institutes for Research, Washington DC: 1-118.	
14) OECD, Organization for economic co-operational and development. (2003). Emerging systematic risks in the 21st century: An agenda for action. France: OCED Publication.	Demography, Environment, Infrastructure, Socioeconomic
15) Smet, Hans De, Patrick Lagadec, and Jan Leysen. (2012). "Disaster Out of the Box: A new Ballgame?" Journal of Contingencies and crisis management 138-148.	Infrastructure
16) Leon, G. R. (2004). "Overview of the psychosocial impact of disasters." Prehospital and Disaster Medicine 19(01): 4-9.	Crime
17) Anwar, H. M. (2008). "The Impact of Recurring Natural Disasters on Chronic Poverty." Societies without Borders 3(2): 285-301.	Poverty
18) Clermont, Carine, David Sanderson, Anshu Sharma, and Helen Spraos. (2011). "Urban disasters: Lessons from Haiti." London: Disaster Emergency Committee.	Relief and Recovery
19) Cutter, Susan L., Jerry T. Mitchell, and Michael S. Scott. (2000). "Revealing the Vulnerability of people and Place: A Case study of Georgetown County, South Carolina."	Demography Infrastructure

Annals of the AAssociation of American Geographers 713-737.	
20) Reza, Mohammad Imam Hasan. 2014. "Importance and considerations for the development of a composit index of ecological integrity of ecological management." *International jornal of ecology & development* (International journal of ecology & development) 32-48.	Environment

2.3 Identified Factors of "Resilience"

It is identified from the literature review that there are few recurring factors that were discussed with respect to resilience for urban settings. These factors can be categorized under following topics:

1) Demography
2) Urban Infrastructure
3) Ecological resilience
4) Socio-economical resilience

Each of these topics will be discussed in detail in later chapters using related resources and a list of issues will be created to help describe and justify the individual factors. Also since defining "Resilience" in planning is a fairly large topic with innumerable factors that can play an important role for creating a resilient urban setting, to contain my research and scope of study, it would be interesting to understand the factors defining "Resiliency" in planning

for costal storm events. Thus it is important to understand the coastal cities and the natural event effecting it before moving forward to understanding the 4 identifies factors.

2.4 Understanding the Coastal areas and the associated natural events:

Coastal areas are referred as the interface or transition areas between land and sea, including large inland lakes. These areas are diverse in function and form, are dynamic and do not have a well-defined or rigid spatial boundaries. Unlike watersheds, there are no exact natural boundaries that unambiguously delineate coastal areas. Due to favorable biophysical and climatic conditions, along with the ease of communication and navigation facilities, these places have been encouraged for human settlements in coastal zones since prehistoric times (Repository n.d.). Hence, the edge of sea is heavily populated in coastal towns and cities. This overwhelming human activity has been modifying the landscape, sedimentation pattern and energy flow in the coastal areas especially by modifying the water flow (dams, water extraction, deviation in the flow of rivers, etc.) and deforestation near the shorelines. This reduces the vertical flow of water and augments salt water intrusion. Deforestation also reduces the sediment deposition on the shorelines, causing the coastline to retreat. Along with the human impact, shorelines are also susceptible to natural events like sea-level rise, tidal surge, storms, and hurricanes. As per the United States National Oceanic and Atmospheric Administration (NOAA) the sea level is currently on the rise at the rate of 3mm/year (which itself is significantly larger than last several thousand years). Intergovernmental Panel on Climate Change (IPCC), United States National Research Council (2010) and National Climate Assessment (NCA) projected that by 2100, the sea level rise might increase by another 18- 200cm (7.1 to 79 inches). Although sea level rise is one of the global factors which affect global climate change, it can vary locally. Many cities

are suffering from land subsidence because of excessive water extraction. With an increase in land subsidence, the sea level rises. This directly affects demography, business, infrastructure and littoral ecosystem by direct loss of land and in coastal areas (especially near deltas) and changes the frequency of extreme events in the ecosystem. This increase in damage to coastal area can be directly linked to increase in the damage to infrastructure, fragility of population and loss of economy. Thus, it is important to understand resiliency in planning for coastal cities in terms of demographic changes, resiliency in natural ecosystem, socio-economic vulnerability, and infrastructure planning, specific to the geographical location of a particular coastal region, which are discussed in further chapters.

3. FACTOR I: DEMOGRAPHY

3.1 Introduction

Demography is the statistical study of human population. It is important to understand demography for resiliency because the damage caused to people and their belongings is a measure of disaster. Today, more than 300 million people live in tropical cyclone-prone area and the number is likely to double in 2050 (Lall and Deichmann 2009). It is important to understand the composition of community vulnerable to natural event for many reasons. These are, firstly, to understand the condition of community before impact, that's adding or aggravating the vulnerability of the place. Second, identify the week zones of the demographic composition (minorities, low income people, population with disabilities etc.) that can accentuate the community loss. Third, understanding the vulnerability of the population will help the planner to design a suitable management and mitigation process. It is therefore, important to understand the census data for cities, the geographical location, percentage of critical population, etc. for providing an effective planning solution.

Recently another growing factor that increases vulnerability of the society are the elderly population and children. There has been a significant increase in population of people of age above 60. By 2050 a third of the population of a city will age above 60 as compared to 19% in 2000 (OECD 2003). This increases the amount of vulnerable population, given any disaster event. Thus planning for such population is also crucial.

Below are few of many issues that are identified and need consideration and a place in planning documents to increase the demographic resiliency of the city.

3.2 Key issues defining the resilience of demography or social resiliency of a city

Since the composition and vulnerability of population varies as per the location, it is important to identify the demographic issues specific to the study area. Since the study area for my practicum is coastal cities, along with some general issues I'll listing some specific issues related to coastal cities only.

1) Geographical location: It is important in coastal cities to understand the physical geography of the location. Many cities have emerged at a location with an easy accessibility to resources, fertile soil and transportation, along with favorable climatic conditions. These geographical settings are prone to hazard events like tropical storm and hurricanes causing flooding and sea-level rise. The impact of such conditions were observed in 2005, when hurricane Katrina hit our cities. It destroyed 80% of New Orleans, caused extreme damage along the central coast of Gulf of Mexico, relocated more than 200,000 people and killed about 1,800 people. It caused extreme damage to the infrastructure (loss of power in South Florida and Cuba) and a total damage of 125 billion dollars (Tomić, Gavrilov, et al., The Impact o f Hurricane Katrina on the United States Tourism Industry 2013). Thus it is important to understand the demographics of people living in the impact zone of the natural event. To calculate that we need information's like:
    a) Geographical location
    b) Possible natural events
    c) Estimated impact zone of the event.

2) Census data: Comparing the census data from 2000-2050, for coastal cities, the overall population susceptible to cyclone impact is going to increase from 310 million people to

680 million people (Lall and Deichmann 2009). Thus it is important to understand the diverse population group in the study area to modify resilience planning for the same. The facts that can help understanding the issues are:

a) Total population of the city
b) Estimated population growth
c) Total elderly population (of age above 60 years)
d) % population under estimated hazard zone
e) % of elderly population under estimated hazard zone
f) % of population with chronic disease
g) Medical services available
h) Emergency health care programs
i) Race and ethnicity
j) % of women population in the hazard zone
k) Education level
l) Education and outreach program
m) Capacity of safe home at the time of disaster
n) Child care facilities
o) Emergency management plans for food supplies and electricity
p) Type of business (source of economy)
q) Potential economic loss to the people after disaster (measuring the property value and insurance rate)
r) Floating population.
s) Employment rate of the city

3) Hazard mitigation plans for people: The purpose of a mitigation plan is to provide a long term implementation of programs and policies to reduce the impact of a natural disaster. Since the preparedness efforts involve and affect the whole community, it's important to coordinate mitigation plans with local organizations. This includes all parts of the community - individuals, businesses, nonprofits, community and faith-based groups, and all levels of governing bodies. Following are the few of suggestions that can help format mitigation plans:

   a) Understanding type of hazard from previous study
   b) Type of infrastructure under hazard (as most of the death and injuries are not caused by the actual hazard event, but its effect on infrastructure)
   c) Open source for valuation of land and property defining the risk associated with the property
   d) Construction standards for the property in the hazard zone
   e) Insurance policies for the properties in hazard zone
   f) Calculating the risk factor for the economic centers
   g) Awareness programs
   h) Health insurance policies
   i) Long term relocation and management plans and relocation plans for the residences in disaster prone areas
   j) Consensus in the management plans of Federal, State and Local governments

4) Management of critical population: Critical population during a natural disaster includes a group of people who are most difficult to evacuate and thus make the city more vulnerable to the disaster event. This group includes a large section of adult population above the age of 60, population below the poverty line, children, and physical disabled people. Following are the factors that might help in addressing the critical population in planning documents:

   a) Percentage of elderly population in the city
   b) Percentage of elderly population with chronic disease
   c) Percentage of population under the poverty line
   d) Medical supply centers for people with chronic diseases
   e) Evacuation facilities for the critical population
   f) Food supply and temporary accommodation
   g) Rehabilitation of population under the poverty line
   h) Early alarm system for critical population
   i) Rehabilitation facilities after the natural disaster
   j) Special insurance policies for people under the poverty line because the property value for them is considerably under the standard/minimum value as required by the insurance policy and hence, most of these properties are not insured under the mandatory insurance policy by FEMA or state laws causing a major damage to the property and infrastructure for this group of population
   k) Education and outreach programs for the critical populations

l) Pet rescue facilities to be included in policies (almost 60-70% of the households in the United States have pets). Older populations are very concerned about their pets and hence, refuse to evacuate.

m) Protection from fraud and abuse, as this group of people are financially exploited by fraud contractors post-disaster.

Above are the few of many issues that need to be addressed in a planning document to maintain the demographic resiliency in a city. In order to develop a resilient planning document for natural events, it is important that governments at all the levels i.e. federal, state, and local level work together to prepare disaster mitigation, management and recovery plans for the cities. Focusing on resilient planning for coastal cities, next is the matrix of issues discussed above – "checklist of issues for a planning document", to achieve demographic resiliency in coastal cities.

3.3 Matrix of issues defining Demographic resiliency for coastal cities

The following matrix was created by reviewing the papers, report, journal articles, and work done by scholars in the field, that can help evaluate the planning document of coastal cities in terms of their demographic resiliency. Along with the list of issues, in the matrix list of supporting documents are also provided that can potentially be use for obtaining information about the identified issues. The matrix consist of 4 other tabs that need to be filled by the information from city or counties document to evaluate the resiliency of the documents. Once the matrix (designed table) is filled with the information from planning documents of the city, its resiliency score will be evaluated, which is described in chapter 7 and 8 of this research.

Table 3-1 Resiliency matrix for Demography, created by Author

Issues of Demographic Resilience	Measurment value	Planning documents			Source of information	Possible sources for data availability
		Addresssed	Not Addressed	Needs an update		
1) Geographical location						
a) Location	Proximity to a natural disaster					USGA Geological data
b) Type of natural disaster	Intensity of the disaster type					National Weather Services- For hurricane path National elevation data- For Sea level rise
c) Estimated boundar or distruction by natural disaster	Path of hurricane or Area under sea level rise					National Weather Service/ National Hurricane Center
d) % Area of city under the estimated boundary of natural disaster (ex: area under 3ft sea level rise)	Area ratio					GIS mapping (overlapping the layers of total area of city and area under estimated boundary of natural disaster)
2) Census data						
a) Total population of city	Total no. of peoples					United state census bureau
b) Estimated population growth	Percentage of population growth in the city in next 10 years					US census bureau- Population projection
c) Population types:						
i) Population under age of 5 years	Percentage of population					US census bureau
ii) Population under age group of 18 years	Percentage of population					US census bureau
iii) Population of age 65 years and above	Percentage of population					US census bureau
d) Percentage of population under the estimated hazard zone	Percentage of population					

e) Percentage of critical population under the estimated hazarad zone						
i) Percentage of elderly population						
ii) Population under age group of 18-65 years						
iii) Population in age group of 18 years and below						
f) Percentage of population suffering from an chronic disease	Percentage of population					Center for Disease Controle, State Profile
g) Location of medical centers	Locational maps and accessibility data					State clearing house, GIS Data
h) Critical facilities provided in the hospitals in case of emergency	list of facilities					Individual hospital website/ Survey
I) Backup plans for the hospital and other medical facilities						
j) Race and Ethinicity	Percentage of population types					US Census data
k) Percentage of population of womens	Percentage					US Census data
m) Education levels	Percentage of populaton					US Census data

i) percentage of population with secondary education						US Census data
ii) percentage of population with high-secondary education						US Census data
ii) percentage of population with college education						US Census data
n) Education and outreach programs for the possibel disaster events and saftey measures	Document					
o) Location of Emergency shelters	Maps showing the possible location of shelters					
p) Approximate capacity of the emergency shelters	Percentage of population its accomodating					State mass care shelter program, and Center for disease controle
q) Child care centers	List of all the child care centers					State mass care shelter program, and Center for disease controle
r) Pet rescue plans	list of agencies that would be involved in pet rescue plans					Federal Pets Evacuation and Transportation Standards (PETS)
s) Emergency management plans for food supply, fresh water and electricity	List of agencies that would be involved					Center for disease controle, Fedral Emergency Management Plans
t) Evacuation plans	List of agencies involved and detail discription for the plan					FEMA Evacuation Liaison team, Fedral highway administration, State Department of Transportation
u) Types of Business	List of all the different types of bussiness and their economic gains					State department of economics
v) Potential economic loss after disaster	percentage of bussiness under the estimated hazard zone					State GIS Clearing house, Tax assessors office
w) Tourist evacuation plan	Document					FEMA- Developing and Maintaing Emergency operation plans

3) Hazard Mitigation plans for people						
a) Understanding the type of hazard	Document					
i) Previous disaster caused by similar disaster						
ii) Awareness programs						
b) Types of Infrastructure under risk of hazard	Percentage of each type of infrastructure					County GIS Data
i) Industrial						
ii) Corporate						
iii) Residiential						
iv) Highways						
v) Electrical grids						
vi) Ports						
c) Property valuation report to understand the risk associated with it at different geogrphical locations.	Document					Tax assessors office
d) Building Construction standerds	List of standerds					FEMA- Home Builder's Guide for Coastal Construction
e) Insurance policies for building in the estimated range of hazard	Special rates for flood insurance of properties under the flood zone or ther natural hazard					Home owener's Guide, Flood insurance rate map for states
f) Critical hotspot mapping for econimic center	Percentage of the critical infrastructure for economical center under the estimated hazard zone					GIS data for business
g) Awareness programs for :						
i) The disaster relief programs	Document					
ii) Proparty insurance programs	Document					
iii) Health insurance program	Document					
iv) Disaster recovery programs	Document					
h) Reocation plan for critical infrastructure and econic center, in the hazard zone	Document type with phase plans for relocation					
4) Management of critical population						
a) Percentage of Elderly population in city	Percentage of population					US Census data
b) Percentage of Elderly population with a chronic disease	Percentage of population					Center for Disease Controle, State profile

c) Percentage of population under poverty line	Percentage of population					US Census data
d) Medical facilities and supply centers for population with chronic disease	Document					Center for Disease Controle
e) Special evacuation facility for critical population	Document					Department of health and human services, FEMA
f) Food suply and temporary accomodation facility, especially for peoples under poverty line	Document					National disaster housing stratagies FEMA, Emergency Support function, FEMA and Department of homeland security
g) Earlier evacuation facilities for critical population	Document					Florida Department of Health, Hospital evacuation tool kit
h) Facilities for low rate insurance policy for population under poverty line	Document					
i) For property						
ii) For health						
i) Special educationa and outreach program for population under poverty line and eldarly population to avoid property fraud, and exploitation after disater	Document					Community eduction and outreach FEMA
Total no of issues under in each catagories						
Source: Produces by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA 2015						

List of Documents used for creating the above matrix for demographic resiliency are:

a) *Economics of Urban Hazard Risk Environment and Energy team, by World bank*

b) *Emerging systematic risks in the 21st century: An agenda for action, an* Organisation for economic co-operationa and development (OECD) publication

c) *Social Vulnerability to Environmental Hazards, by Susan L. Cutter*

d) *Assessing Community Impacts of Natural Disasters, by Michael K. Lindell and Carla S. Prater*

List of supporting or reference document were created by online research about the identified issues and related legitimate sources of data available. The purpose of list was to addresses few of many important issues for demographic resiliency. Next section is about understanding the issues defining the resiliency of urban infrastructure.

4. FACTOR II: URBAN INFRASTRUCTURE

4.1 Introduction

Urban infrastructure can be defined as the physical or organizational framework supporting the functioning of the city. Since infrastructure can be defined as any permanent framework supporting the super structure, this section will discuss about both, the physical and regulatory frame work as in case of resiliency, the super structure would be the entire city. Infrastructural failure can be measured by its structural failure, social, and economic impact of the failure (Oh, et al. 2013). In this section, I will be discussing these three criterions for measuring resiliency of both physical infrastructure (road, bridges, pipelines, etc.) and the organizational infrastructure (regulation, insurance, local laws, etc.).

4.2 Physical infrastructure

Loss of physical infrastructure in disaster can cause substantial dislocation and distress to the people. Loss of electric power, water, transportation, and other lifeline infrastructure system results in far-reaching impact - from impairing efforts of safe evacuation of people from their homes, to causing economic losses to the public (Chang 2003). When hurricane Katrina hit Florida, New Orleans and Mississippi, it generated great economic loss. The cost of restoration was approximately 108 billion dollars and further economic damage was caused due to restrictions in production and transportation (Tomić, Gavrilov, et al., The Impact of Hurricane Katrina on the United States Tourism Industry 2013). In order to avoid such circumstances, it is important to understand the issues that define the resilience of physical infrastructure. According to the assessment carried out in 2008 by the ASCE (American society of civil engineering), the

cumulative grade of the infrastructure in the United States rose to D+ from D (ASCE 2013). It also demonstrates that there is still, a lot of scope for improvement in the current conditions of infrastructure. Failure of infrastructure not only depends on the condition of the infrastructure, but also on the impact zone of the structure. Also the criticality of infrastructure depends on the community's dependence on it (Oh, et al. 2013). Therefore, to measure the criticality of infrastructure, it is important to understand the type of hazard it's in.

4.2.1 Identifying the Risk

For identification of risk it is important to first understand the types of infrastructure that can be effected by the natural event and in return will affect the social setting and the economy of the city. A recent example is the cyclone Hudahud that hit the city of Vishakhapatnam in the state of Andhra Pradesh, India, completely ravaged the port area, causing major damage to critical port infrastructure, trawlers and merchandise ships. The incidence caused further damage to the economy by making fishermen jobless for long time (Patnaik 2014). It is important to measure the resiliency of urban infrastructure so as to reduce the risk of economic losses in the city. Number of issues needs to be considered for identifying the risk in the infrastructure and those issues are identified using the following resources:

- *CRS (Congressional Research Services) Report for Congress: Critical Infrastructure and Key Assets, Definition and Identification.*
- *2013 Report cred for America's Infrastructure by American Society of Civil Engineering (ASCE)*
- *Appendix a: sector-specific agencies for critical infrastructure and Key resources; FEMA, Critical Infrastructure and Key Resources Support Annex.*

- *Revealing the Vulnerability of People and Places: A Case Study of Georgetown County, South Carolina by Susan L Cutter, Jerry T Mitchell and Michael S Scott.*

Using the resources (states above) following are the identified issues that can help in understanding the physical infrastructure and the impact of natural event on it.

1) Understanding the type of natural disaster: It is important to understand the kind of natural event we are dealing with. This can be done by learning about the history of the place and identifying the types and frequencies of natural events that have taken (Lindell and Parter 2003)place in the study area (Cutter, Mitchell and Scott 2000).
2) Understanding the zone of impact of the natural disaster: This depends on the type of natural disaster we are considering. Some disaster-types have a well-defined impact area like flood plains, fault lines, etc. but for others like for hurricane we need to guesstimate the probable impact zone from the predictions made by scientific research and history of the place (Cutter, Mitchell and Scott 2000).
3) Identifying the types of critical infrastructure available: Criticality of infrastructure relies upon the dependency of various functions on that particular infrastructural facility. When disaster hits a place, this infrastructure plays an important role in disaster response and later, supporting the other activities and resume its functioning (Oh, et al. 2013). This critical infrastructure varies from place to place but few common ones identified critical by CRS, ASCE, and FEMA are:
    a) *Road network, bridges*: According to a research by American Society of Civil Engineers (ASCE) on American Infrastructure, there are 4 million miles of road network in the United States, providing transportation for approximately 3 trillion vehicle miles a year (ASCE 2013). These not only provide

connection to the ports, rail terminals, schools, hospitals, city centers, etc., but also drive the economy of the city. The assessment report of the road conditions by ASCE also states that 32% of America's major roads are in poor or mediocre condition.

b) *Drinking water supply*: Water is a basic life support for human beings. In the United States, there are 170,000 public drinking water systems serving the entire population (ASCE 2013). Although there is a constant effort taking place in upgrading the infrastructure, the overall system is in poor or mediocre condition, causing more than 2 million water main breaks in the country (ASCE 2013). Any impact on this infrastructure would not only cause the interruption in the supply of clean drinking water, but also increase the long term risk of water contamination causing severe health problems in the country.

c) *Dams*: Dams were constructed to store drinking water, produce hydro-electricity, protect farmlands, and for flood protection. According to ASCE report there are approximately 84,000 dams in the country over 50 years old. Thus, any impact caused to them due to a natural event can accentuate the effect of the natural hazard.

d) *Levee*: Levees were constructed to protect people from the devastating effects of floods. According to ASCE there are more than 100,000 miles of levee present in United States maintained and controlled by the local authorities. It is, therefore, very important for local authorities to evaluate the condition of

the physical structure of levee and the approximate capacity of the structure to have an idea of intensity of the disaster the city is dealing with.

e) *Waste management (Hazardous and solid waste)*: It is important to manage waste because events like flood, hurricane, etc. will augment the possibility of water contamination.

f) *Energy (power, gas, and telecommunication)*: Loss in energy supply not only has an economic impact but also a social impact. It involves a huge investment in restoring power supply. But most importantly, it hinders the rescue process by immediate loss of communication and create chaos among the people.

g) *Safe home*: It is important to evaluate the capacity of safe home depending on the number of vulnerable populations. The criteria of vulnerable populations can vary from place to place.

h) *Emergency health care facility*: Availability of critical health care facilities reduces the social vulnerability of the critical populations (children, women and elderly) by providing them immediate support.

i) Apart from above described facilities which are critical to the cities but its impact zone is less prominent that the once discussed above. These facilities are; government services, banking and financial zones, prison, identification of hazardous activities like, chemical factories, nuclear power plant, etc., defense and safety, and agriculture and food supply system (Moteff and Parfomak 2004) (FEMA, Critical infrastructure and key resources support annex 2008).

4.2.2. Calculating the critical Infrastructure

It is important to calculate the critical infrastructure of a particular location. Various research have been done in past to identify the critical infrastructure of a place and most are suggesting, firstly the identification of important infrastructure depending upon the impact zone of the activity, its social dependency and economical dependency. Then mapping them within the impact zone of natural event. Eun Oh Ho, Abhijeet Deshmukh and Makarand Hastank in their report, *"Criticality assessment of lifeline infrastructure for enhancing disaster response, looked at the data's like demography of the place"*, suggested identification of, lifeline infrastructures like road, business, power supply, and many more, level of damage cause by each infrastructure in the economy and social conditions, duration of service failure (lesson from similar events in past), and list of functions disrupted by the impact on the critical infrastructure. A relative level of criticality was calculated by normalizing this data by social and economic impact (Oh, et al. 2013). Another method of calculating the critical infrastructure is by mapping them via geographic information system. This method is discussed by Susan L. Cutter in the article, *"Revealing the vulnerability of people and places: A case study of Georgetown County, South Carolina"*. The process involved, mapping the population density, critical infrastructure (roads, chemical industries, rail road, hospitals, etc.), potential natural events, its probable impact zone, frequency of the event (from history of the place), and the locational impact of the event. All these layers were super imposed to generate the hotspot of critical infrastructure. For more accurate depiction, a layer of social vulnerability was also mapped and super imposed on the previous layers (Cutter, Mitchell and Scott 2000). Although none of the above method provides an exact method to calculate the critical infrastructure present in the city, but it at least gives a good

understanding of a place and at least provides us with the basic knowledge of the possible weak and important zones in the city.Next section is the matrix of most of the factors that are useful for identification of a critical infrastructure.

4.2.3 Matrix of issues defining resiliency of physical infrastructure in coastal cities:

The matrix for defining resiliency of physical infrastructure was created by listing the issued and important factors identified from the above discussion and understanding the details that can help in addressing those issues. The structure of this matrix is very similar to that for demographic resiliency. It consist of list of issues, their measurement values and the possible resources from where the data and information about the issue can be acquired. Along with that there are 4 other tabs in which the specific information's from the city/county can be provided for the evaluation of the document. This section can help in quick elevation of the resiliency of the physical infrastructure.

Table 4-1 Resiliency matrix for Physical Infrastructure, by Author

Issues of Resilience in physical infrastructure	Measurment value	Planning document of city			Source of information	Possible sources for data availability	Documents referred
		Addresssed	Not Addressed	Needs an update			
1) Nature of natural event							
a) Type of natural disaster	List of disaster events place is suceptable to (study from history of the place)					NOAA national weather service, Office of climate, water and weather services	(Oh, et al. 2013), (Cutter, Mitchell and Scott 2000),
b) Frequency of natural disaster	(No. of events x 100) ÷ (No. of years)					FEMA, national reaserch council, local news sources	Cutter, Mitchell and Scott 2000

c) Zone of impact of natural disaster	mapping the area of impact for natural disaster					NOAA GIA data for hurricane, FEMA floof map	Cutter, Susan L., Bryan J. Boruff, and Lynn W. Shirley. 2003, Cutter, Mitchell and Scott 2000
d) Forms of impact caused by the natural event	Distruction caused throurh water, gas, or solid					Study of different types of natural disaster	Lindell, Michael K., and Carla S. Parter. 2003
2) Identification of Critical Infrastructure							
a) identification of frequently used infrastructure	Interviews from local public					Interviews and local comminity data	Oh, et al. 2013
b) Comparing it with the list of critical infrastructure identified by CRS, FEMA, ASCE	list of data already identified before					*2013 report card for America's Infrastructure.* American Society of Civil Engineering; Critical infrastructure and key resources support annex. Fedral	Moteff, John, and Paul Parfomak. 2004; Oh, Eun Ho, Abhijeet Deshmukh, Makarand Hastak, and
c) Normalizing the identified infrasyructure as per their social and economic contribution	Interviews of the people as per the usage of the infrastructure					Inputs from local government and citizens	Oh, et al. 2013
d) Calculating the impact of few major infrastructure:							

i) Electricity	Calculating the social and economic impact of power outage						Oh, et al. 2013
ii) water	Calculating activities dependent on water supply						Oh, et al. 2013
iii) road	Identifying the important road network and its supporting population					State Department of transportation	Oh, et al. 2013
e) Mapping of the identified critical infrastructure in the hazard impact zone	Map showing the location of infrastructure					Local researchers	Lindell, Michael K., and Carla S. Parter. 2003
f) Evaluating the physiscal condition of the critical ifrastructures	Report					American society of civil engineers, state chapters	ASCE. 2013. *2013 report card for America's Infrastructure*

3) Regulations for maintaining the critical infrastructures							
a) Funds and policies for improving the conditions of critical infrastructures	Report					Water supply improvement program (WSIP), Pre-Disaster Mitigation Funds (PDM) From FEMA, Beach Act by Enviormental protection Agency, Clear water state revolving funds, etc.	ASCE. 2013. *2013 report card for America's Infrastructure*
b) Construction and improvemnet standerds (for existing structures) for critical infrastructures	Report					FEMA building construction coads	FEMA. 2005.Summary of Coastal Construction Requirnment and Recommendatio n
c) Insurance policies for the critical infrastructure	Report						
d) Phasing of the relocation policies for the critical infrastructure.	Report						
e) Identification of the critical population group associated with the critical infrastructure	Report						
f) Special health care facilities for the critical population during the time of natural disaster	Report						

g) Programs for alternative way of communication during the disaster conditions	Program and product development					Cell on wheels program	(Jha, Miner and Zuzana 2013)
Total no of issues under in each catagories							

Source: Produced by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA 2015

4.3 Organizational Infrastructure

Organizational infrastructure refers to the regulatory policies and procedures that act as the framework to support the functioning of a city. The mitigation, response and recovery strategies are important for reducing the impact of the natural disaster. Different agencies (federal, state and local agencies, industrial experts, city managers, environmental agencies, etc.) need to work together to create these policies which are flexible enough to be adopted in the organizational structures of counties. The United States Department of Homeland Security in their report for National Response Framework specifies that these organizational structures can be divided into four groups – emergency support functions, support functions, incident functions and partners (security 2008). Other categories in which the organizational policies are divided into for hazard planning are – mitigation, preparedness, disaster response, recovery and reconstruction (Jha, Miner and Zuzana 2013). For the ease of the discussion, I will be discussing the organizational infrastructure under the heads mitigation strategies, preparedness, disaster response, recovery and reconstruction.

4.3.1 Policies and regulations defining organizational infrastructure:

It is important to understand the different set of policies that exist in creating these support systems, so that we can phase out the time efforts and funding according to the criticality of the issues. Following are the four phases of the policies for resilience for natural hazard situations:

Phase I: Mitigation Strategies

Mitigation strategies or plans are important because they lead to actions that help in sustaining or eliminating the risk of future disaster events. A properly planned and implemented mitigation plan can help in protecting public safety, loss of life, harm caused to future development, protecting the economic and cultural assets of the communities, minimizing the operational loss and recovery time, reducing cost of disaster response and recovery, etc. (FEMA, Local mitigation planning handbook 2013). Mitigation strategies are a long term planning process, which are developed based on the assessment of a natural event city is susceptible to, risk assessment and vulnerabilities. Abhas Jha in his books *Building urban resilience* and *Tools for building urban resiliency*, has described key points as steps or considerations for mitigation planning. Also FEMA in the report for *Building urban resiliency*, has identified few important considerations required for creating proper mitigation strategies. These considerations are described as follows:

i. *Risk assessment*: It is important to understand the type, size and frequency of a risk to create a management plan for a specific condition. The main purpose of risk assessment is to quantify the impact of risk (Jha, et al. 2012).

ii. *Economic impact*: Calculation of economic impact helps us in assigning monetary value to the impact of the natural disaster. Thus investments needed for mitigation actions can be calculated as well.

iii. *Social impact*: Calculation of social impact helps in prioritizing the critical zones for phasing-out the implementation of the mitigation strategies.

iv. *Critical infrastructure*: Regulations for critical infrastructure, as identified by social and economic impact of the natural disaster are important to avoid major post-disaster financial crises and for easy implementation of disaster management framework.

v. *Ecosystem management*: It is important to have ecosystem management policies, to strategically use the available ecological system for mitigating the effects of the natural disaster and reduce the un-necessary construction and maintenance of the physical urban infrastructure.

vi. *Phasing for risk based land use planning*: Risk based land use planning primarily deals with the relocation of the section of society and critical infrastructure to a safer zone (outside the impact zone of the natural event). Phasing helps in defining priorities in risk based land-use planning.

vii. *Involvement of governmental agencies and stakeholders*: Involvement and consensus of federal, state and local agencies and stake holders is important for an integrated mitigation policy-making process.

viii. *Disaster management framework*: Mitigation plans under this section are important for quicker and more efficient management of the workforce during the actual disaster situation.

ix. *Funding sources*: Implementing disaster mitigation policies is a long and expensive process, involving multiple agencies to work together to reduce the impact of the natural disaster. Therefore, proper evaluation of investment and plans for procuring funding from the government agencies is important for smooth implementation of all the phases.

x. *Insurance*: Insurance is one of the most important policies constructed by close evaluation of the loss occurred due to the disaster and to protect the stake holders from major wreak.

Phase II: Preparedness

As the impact of natural event cannot be avoided, the best thing is to be prepared for it to mitigate its impact. Preparedness measures can be taken in different hierarchal groups for the resilience of the country as a whole. Preparedness at the **Federal level** is creating mitigation strategies. Plans in the **state level** and the **county level** include data collection measures like weather and demographic data, important infrastructure, condition of the infrastructure, development of early warning systems, land use planning, etc. At a **local or community level** the preparedness plans are specifically drafted to prepare the local population for the hazard. This mainly deals with preparation of safety plans for emergency conditions considering the local population. Although many groups like America's Red Cross, Center for Disease Control, Environmental Protection Agency, United States Food and Drug Association, World Bank's Community Driven Design Program etc. are led by Federal level organizations, but operated by local governmental bodies for the preparedness of the people within the community.

Phase III: Disaster response

Disaster response is effective for a very short period of time for saving peoples' life. But the management of such policies is a long term process and involves a lot of agencies. Following are a few agencies involved in the immediate disaster response process:

i. "Pre-disaster" warning organization, working on constant tracking of weather condition to provide early warning to people and rescue team (R 2006).

ii. Managing the group of volunteers for safe evacuation of population. (Cross 2013)

iii. Emergency response team providing transportation for quick evacuation

iv. Relief homes and shelter facilities providing temporary accommodation, food supplies, and medical attention to the victims

v. Health organization to provide healthcare facilities for the critical population

vi. Food and agriculture department to manage the supply of food

vii. Childcare facilities

viii. Management of technical assistance to maintain the communication in the affected zone

ix. Management of the team of volunteers for cleaning up the debris.

x. Management of armed forces and trained solders to manage the chaos and crime.

Phase IV: Recovery and Reconstruction

Recovery and reconstruction policies can best be described as a stepwise process leading the community towards normal functioning. The effective function of recovery and reconstruction plans depends on the successful functioning of the mitigation, preparedness and disaster management policies. Recovery process can be defined as short-term recovery process and long-term recovery process.

i. Short term recovery plans: Short term recovery plans are usually the immediate initiatives adopted for stabilizing the situation. Some of the essential elements of the short term recovery process are – search and rescue troops, damage assessment, public information, temporary housing, utility restoration and debris clearance (Philipsborn 2005). But even the short term plans should be based on understanding of reasons of failure and plans in the long term recovery process to obtain successful long term effect.

ii. Long term recovery plans: Long term recovery plans provide the community with a framework for a long and steady recovery process. It is a process to re-establish the healthy functioning of the community (FEMA, Introduction to the long-term community recovery 2005). According to FEMA the seven enablers for holistic long term recovery process are – stakeholder participation, political will, authority, funding, priority, vision, and community endorsement.

Next is creating a matrix using the issues that have been discussed above, under the four phases.

4.3.2 Matrix of available policies for resiliency of organizational structures:

The resiliency matrix was created using the issues identified under each phase of the planning document. Although the thought behind creating this matrix is same but the structure is a little different from that of demography and physical infrastructure. For the matrix of organizational infrastructure, to address each identified issues (in sections above) for different phases, list of national, international, governmental agencies were created, along with different reports and documents they have addressing those issues. A point will allotted to the planning document if it shows compliance with any one document of at least one

agencies listed in the matrix (related to that particular issues). The list of the agencies and available document were created by online research through the official sites of those government agencies.

Table 4-2 Resilience matrix for Organizational Infrastructure, by Author

Phases of organizational s+A1:H20tructure	Agencies involved	Guides provided by agencies and researchers	Planning documents of city			Source of information	Documents referred
			Implemented	Not Implemented	Needs an update		
1) Mitaigation plan							
a) Risk Assessment	*FEMA (Fedral emergency management Agency)*	National Hurricane Center					(Jha, Miner and Zuzana 2013); (Oh, et al. 2013)
		Historical Hurricane Tracks					
		FEMA flood hazard mapping					
		National Geophysical Data Center					
		National water and climate center					
		National climatic data center					
		National hazards center					
		Flood map service center					
		Floods and Flash Floods Information					
		FEMA national flood hazard layer					
		FEMA, HAZUS-MH Software					
	USGS (United States Geological Survey)	National Flood frequency Program					
		USGS Natural Hazard Gateway					

	NASA (National Aeronautics and Space Administration)	Global Flood hazard frecquency and distribution					
	NOAA (National Oceanic and atmospheric administration)	NOAA Coastal Service Center					
		Weather Saftey and Preparedness Brochures					
	Arc GIS (Geographic information system)	Flood frequency class mapping					
b) Economic impact	IDB (Inter-American Development Bank)	Economics of natural disaster					(Oh, et al. 2013)
	National Academy Press	The Impace of Natural Disaster					
	The World Bank	Economics of natural disaster					
	FEMA (Fedral Emergency Management Agency)	Economic Application of Natural disaster					
		Economics of natural disaster					
		Developing the Mitigation Plan: Identifying the Mitigation actions and implementation strategies					
	SHIELDUS data set (Spatial Hazard Events and Losses for the United Stated	Data Reports and Mapping of economic loss of natural disaster					
c) Social impact	*The world bank*	Popualation at risk of Disaster					(Oh, et al. 2013)
	US AID	Guide to education in natural disaster					

	FEMA (Fedral Emergency Management Agency)	Hazard Vulnarability and risk Analysis					
	Inidviadual papers/ Reports						
	i. Social Science quaterly	Social Vulnarability to environmental hazard by Susan L. cutter, et.al.					
	ii. American economic review	Poverty aand Vulnerability					
	World health statistics quaterly	Natural and man made disater: the vulnarability of women-headed household and children without family					
	CDC (Center for Disease Controle)	A Social Vulnarabilty Index for Disaster Management					
d) Critical Infrastructure	*ASCE (American Society of Civil Engineering)*	2013 Report for American Infrastructure					(Jha, Miner and Zuzana 2013); (Oh, et al. 2013)
		Guiding Principles for the Nation's Critical Infrastructure					
	United Nations ESCAP	Building Resilience to Natural Disaters ad Major Econimic Crises					
	NIPP (National Infrastrastructure Protection Plan) 2013	Partnering for critical infrastructure security and resilience					
	Department of Homland security	Protected Critical Infrastructure Information (PCII) Program					

		Regional Resiliency Assessment Program					
		Office of Infrastructur Protection Strategic Plan:2012-2016					
		National Infrastructure protection plan					
		Infrastructure Survey Tool					
	United States Government Accountability Office	GPS Disruptions: Effrts to assess risk to critical infrastructure and coordinate agency action should be enhanced					
	FEMA (Fedral Emergency Management Agency)	Critcal Inrastructure resourse center					
		Critical Infrastructure and Key Resources Support Annex					
		FEMA online courses: protecting Critical Infrastructure					
		Critcal Infrastrcture protection and Resilience Toolkit					
		Asset Value, Threat/Hazard, Vulnarability and Risk Assessment					
		Risk Management Series					
		Building and Infrastructure Protection Series					
		Risk Management Series: Design Guide for Improving Critical Facility Safety from Flooding and High Winds, FEMA 543					
	US Energy Informaion Administration	Flood Vulnarability Assessment					
	U.S Department of Commerece	National Institute of Standerds and Technology (NIST)- Developing Guidelines and Standerds for Disaster Resilience of the Built Environment					

e) Ecosystem management	*International Union of Conservation of Nature*	Ecosystem, Livelyhood and disaster: An integrated approch to disaster management					(Jha, Miner and Zuzana 2013); (Philipsborn 2005)
	UNISDR (Uinted nations international strategy of disaster reduction	opportunities in environmental management for disaster risk reduction: Recent progress					
	IUCN (International Union for conservation of nature)	Environmental Guidance Note for Disaster Risk Reduction					
	EPA (United States Environmental Protection Ageancy)	Flood plain Laws and Regulations					
	FEMA (Fedral Emergency Managent Agency)	Executive Order 11988: Floodplain Management					
	IPCC (intergovernmental pannel for climate change)	Climate change 2013: The physical science basis					
f) Land-use planning	*FEMA (Fedral Emergency Managent Agency)*	Building Community Resilience by Integrating Hazard Mitigation: Integrating Hazard Mitigation Into the Local Comprehensive Plan					(Jha, Miner and Zuzana 2013); (Philipsborn 2005)
		Policeis for guiding for Post-Disaster Recover and Reconstruction					
		Landuse plannign for Hazard Mitigation					
		FEMA local mitigation planning Handbook for commmunity					
		Local mitigation planning handbook					
	APA (American planning Association)	Hazard Mitigation: Integrating best practice into planning					

g) Disaster magement Framework	*FEMA (Fedral Emergency Management Agency)*	National response framework					(Jha, Miner and Zuzana 2013)
h) Insurance and Funding	*FEMA (Fedral Emergency Management Agency)*	Recovery and Rebuild Program					(Jha, Miner and Zuzana 2013)
		The national Flood insurance program					
	American Red Cross	Recovering Financially					
	The World Bank	Disaster risk managenent					
2) Community Preparedness Policies							
Awareness and Supplie management	*American Red Cross*	Redcross Emercency Preparedness Checklist					
	FEMA (Fedral Emergency Management Agency)	America's PrepareAthon: National Prepareness program					
		Basic Preparedness Kit					
	CDC (Center for Disease Controle)	Emergency prepardness and response					
What to do?	*FEMA (Fedral Emergency Management Agency)*	Are You Ready? An in-depth Guide to Citizen Preparedness					
	American Red Cross	Disaster preparedness for Seniors by seniors					
		Disaster and Saftey Library					
	CDC (Center for disease controle)	Emergrncy Preparedness and Response					

3) Disaster Response							
a) Warning	*NASA (National Aeronautics and Space Administration)*	NASA GPS System for Hazard warning					(Jha, Miner and Zuzana 2013)
	UNISDR (United Nations. International Strategy for Disaster Reduction)	Developing Early Warning System: A Checklist					
		Guiding Principles for Effective Early Warning					
	USGS (United State Geological Survey)	Early Warning and Environmental Monitoring Program (EWEM)					
	ArcGIS (Esri's Geographic Information System)	Early warning System					
b) Response team	*International Rescue Committes*	Emergency response relief team					(Philipsborn 2005)
	ASPCA (American Society for the Prevention of Cruelty to Animals)	Natural Disaster Rescue program					
	FEMA (Fedral Emergency management Agency)	Community Emergency Response Team					
		National Incident Management Syatem					
c) Shelter facility	CDC (Center for disease controle)	Infection Control Guidance for Community Evacuation Centers Following Disasters					(Jha, Miner and Zuzana 2013); (Philipsborn 2005)
	FEMA (Fedral Emergency management Agency)	Risk Management Series: Design Guidance for Shelters and Safe Rooms FEMA 453					

	Pennsylvania, Emergency Management Agency	Disaster Preparedness Planning Guide For Facilities					
	Department of Homeland Security	Disaster Assistance Improvement Program (DAIP)					
d) Health Facilities	*CDC (Center for disease controle)*	Infection Control Guidance for Community Evacuation Centers Following Disasters					(Cutter, Boruff and Shirley, Social vulnarability to environmental hazard 2003); (PERI 2005)
	American Red Cross	Disaster Services					
	FEMA (Fedral Emergency management Agency)	Emergency Support Function #6 – Mass Care, Emergency Assistance, Temporary Housing, and Human Services Annex					
	WHO (World health Organization)	Hospital Emergency Response Checklist					
	United States public health service	Disaster Inspections of Medical Facilities					
	National Association of Community Health Center	Assistance Before, During, and After Emergencies and Disasters					
	International Fedration of Red Cross	Emergency Health Servicce					
	Joint Commission	Standing Together: An Emergency Planning Guide for America's Communities					
e) Child Care facilities	NACCRRA (National Association of Child Care Resource & Referral Agencies)	Protecting Children in Child Care During Emergencies					(Jha, Miner and Zuzana 2013); (PERI 2005); (Cutter, Boruff and Shirley, Social vulnarability to environmental hazard 2003)

	National Institute of Health	Maternal health considerations during disaster relief					
	Office of Child Care	State Regulatory Requirements for Emergency Preparedness Planning					
	Development Bureau, Child Care Licensing Unit, Child Care Resource and Referral Network, NH Emergency Management of Department of Safety and Easter Seals NH.	Family Child Care Emergency Preparedness Guide					
	CDC (Center for Disease Controle)	Guidelines for the Management of Acute Diarrhea After a Disaster					
	FEMA (Fedral Emergency management Agency)	Post-Disaster Reunification of Children: A Nationwide Approach					
	Department of Homland security	Supplemental Resource: Children in Disaster Guidance					
f) Communication Facilities	*Fedral Communication Commission*	TPS (Telecommunication Service Priority) Program					(Jha, Miner and Zuzana 2013)
		GETS (Government Emergency Telecommunication Service)					
		WPS (Wireless Priority Service) Program					
g) Clean up	*SBA (US Small Business Administration)*	Guide to cleaning up saftely after a disaster					(Jha, Miner and Zuzana 2013); (PERI 2005)
		Cleaning and Sanitizing with Bleach After an Emergency					
		Cleaning Flood Contaminated HVAC Systems: A Guide for Building Owners and Managers					

		Dealing with Debris and Damaged Buildings					
		Disposing of Debris and Removing Hazardous Waste					
		After a Hurricane or Flood: Cleanup of Flood Water					
		Flood Cleanup Fact Sheet					
		Mold Cleanup in Schools and Commercial Buildings					
	CDC (Center for Disease Controle)	Flood Water After a Disaster or Emergency					
		Fact Sheet: Clean Up Safely After a Disaster					
	US EPA (US Environment protction Agency)	Planning for Disaster Debris					
		Planning for Polychlorinated Biphenyl (PCB)-Containing Disaster Debris					
	FEMA (Fedral Emergency management Agency)	Debris Management Guide					
4) Recovery and Reconstruction							
Short-Term and Long-Term Recovery Plans	*FEMA (Fedral Emergency management Agency)*	National Disaster Recovery Framework: Community Planning and Capacity Building Recovery Support Function					(Jha, Miner and Zuzana 2013); (PERI 2005)
		National Disaster Recovery Framework Strengthening Disaster Recovery for the Nation					
		Policies for Guiding Planning for PostDisaster Recovery and Reconstruction					

		Disaster Assistance: A Guide to Recovery Programs FEMA 229(4)					
		Continuity Plan template for Federal Departments and Agencies					
		Planning for Post-Disaster Recovery and Reconstruction					
		Long Term Community Recovery Planning Process: A Self-Help Guide					
	American Red Cross	Disaster Recovery: A Guide to Financial Issues (A5076).					
	EPA (Environmental Protection Agency)	American Recovery and Reinvestment Act (ARRA) of 2009					
		Beach Grants					
		Catalog of Federal Funding					
		Clean Water State Revolving Fund					
		Drinking Water State Revolving Fund (DWSRF)					
		Federal Funding for Water/Wastewater Utilities in National Disasters (Fed FUNDS)					
		Safe Drinking Water Act					
		Watershed Funding					
	Public Entity Risk Institute	HOLISTIC DISASTER RECOVERY Ideas for Building Local Sustainability After a Natural Disaster					
	OECD (United states Organisation of Economic Co-operation and Development)	Building resilient regions: Lessons for policy making in post-disaster regions					
	DERA (Disaster preparedness and Emergency Response Association)	Colorado Flood recovery plan					

	American Red Cross	Disaster Recovery: A Guide to Financial Issues (A5076).					
		PICKING UP THE PIECES AFTER A DISASTER Important Steps for Your Safe and Speedy Recovery					
	IEG (Independent Evaluation Group) World Bank	Natural Disaster Response Lessons from Evaluations of the World Bank and Others					
Total no of issues under in each catagories							

Source: Produced by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA 2015

5. FACTOR III: ECOSYSTEM MANAGEMENT

5.1 Introduction

Ecosystem acts as a natural protection from a particular disaster event. It is a great shock absorber for any distress caused in nature by sudden instability in the system, thus helping in maintaining a balance within the community dependent on it. Natural ecosystem not only supports our society by providing livelihoods (food, drinking water, fresh air, fire wood, medicines, etc.), but also provides protection from natural events. Ecosystem protection is a very cost effective and natural way of creating natural buffers for climate change – coral reefs for flood protection, soil stabilization, wetlands, forests etc. ((ICUN) 2012). It is thus important to think of new solutions for protecting and restoring our natural ecosystem as there is a limit to protecting and updating physical infrastructure of our human society. Moreover, ecosystem protection naturally prevents development along the weaker zones, reducing the demographic vulnerability to a natural event (Sudmeier-Rieux 2013). Thus, for good management of the ecosystem, it is important to understand and manage the ecosystem of the location for a more resilient future.

5.2 Understanding the ecosystem

The most important step before modifying the ecosystem is to understand it thoroughly – the type of ecosystem, changes occurred in it, services it supports and existing regulations for its preservation. This research is shown as under:

a) *Climate change:* According to EPA (Environment Protection Agency) a few causes of climate change are variations in the green-house effect, sun's energy

entering the earth's atmosphere and change in reflectivity of the earth's environment and surface (Environment Protection Agency 2014). One of the main reasons behind these changes is deforestation and urbanization caused by depletion of forest land and an increase in the impervious surfaces (Reza 2014). This disturbance in the ecosystem and environmental degradation increases the risk of extreme weather events like floods (floods can be prevented by the preserved areas of ecosystem either by providing sufficient space for overspill and enough pervious surface or infiltration). Our natural ecosystem also protects us from landslides, tidal waves and storm surges, storms and hurricanes by providing a buffer to mitigate the immediate effects of the disaster event (Nigel Dudley, Sue Stolton,Alexander Belokurov, Linda Krueger,Nik Lopoukhine, Kathy MacKinnon,Trevor Sandwith and Nik Sekhran 2010). Since this research is focused on the coastal cities of Georgia, USA, I am listing the most common natural events the study area is susceptible to – issues which will be discussed in further detail in this chapter. These natural events are floods, sea level rise, and hurricanes.

b) *Measuring the climate change:* The occurrence and increase in disaster events is not a random event, but a result of the decisions and modifications in both, social and natural environments. Any natural event becomes a disaster at the convergence point of the natural event and the vulnerable social conditions (UNEP 2005). Therefore, to understand the cause of the disaster, it is important to understand the factors affecting climate change. These factors are identified by

“The World Bank” and listed as indicators for climate change (Bank, Indicators 2015).

Topography: Understanding the topography of an area in terms of the percentage of land area with a lower elevation, which is susceptible for flooding and sea level rise.

Agricultural and forested land: Calculation for percentage of agriculture and forested land available in the study area.

Understanding the air quality: Documenting the amount of greenhouse gas emissions in the atmosphere due to urbanization.

Energy: Calculating the amount of energy and power supply is required for the functioning of the city. This is done for calculating the heat emission in the environment due to usage of such energies.

Clean water supply: Quantity of the fresh water extracted from the ground for serving the population in the study area.

Understanding the demography of the place: It is important to understand the human intrusion in the natural ecosystem to calculate the vulnerability factor of climate change. This includes the total population of the place, percentage of urban, rural and critical populations.

Infrastructure: This is the calculation of amount of infrastructure provided for supporting the population of the place. Infrastructure involves construction activities, which require the removal of the existing green fabric of the ecosystem. Hence, infrastructure is one of the main reasons for an increase in greenhouse effect and reducing carbon sequestration.

c) *Effects of climate change:* After understanding the factors causing climate change, the next step is to understand its effects. While considering coastal cities, this research will discuss the effects of climate change, only in the coastal regions.

Flooding and Sea Level rise: For coastal cities, flooding and sea level rise is one of the most frequent problems. It can be a result of many different natural events including glacier melts, storms, hurricanes, and extreme rain events. All these natural events are repercussions of an increase in temperature and climate change. The list of effects of floods and sea level rise on a social ecosystem is long. It not only creates a life threatening conditions for the population (specifically the critical population) but also increases the risk of contamination of drinking water, damages the physical infrastructure, causes loss of connection and economy and spreads diseases ((NRDC) n.d.). To reduce the vulnerability of the human ecosystem due to floods, it is important to address two considerations. Firstly, provide sufficient space for overspill of water and provide enough pervious surfaces for absorbing and reducing the flow of water in other areas (Nigel Dudley, Sue Stolton,Alexander Belokurov, Linda Krueger,Nik Lopoukhine, Kathy MacKinnon,Trevor Sandwith and Nik Sekhran 2010). This can be achieved by preserving marshlands, wetlands, maintaining the riparian buffers around the waterbodies, maintaining the existing natural lakes and many more. Few grey solutions can also be adopted to reduce the impact of flooding, which include, levees, flood walls, implementing land use plans and building codes for restricting and standardizing construction near the coast lines, etc.

Hurricanes and Storm surge: Hurricane is a type of tropical storm, which forms over tropical or subtropical water. This tropical storm-surge originates in the Atlantic basin, which includes the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico, the Eastern North Pacific Ocean, and less frequently, the Central North Pacific Ocean (NOAA 2014). Examples of Hurricane and storm events that have hit the United States are hurricane Katrina (killed approximately 1,200 people and left thousands homeless), tropical cyclone Sandy in 2012 (caused a damage to the infrastructure worth billions of dollars). To reduce this damage caused to human infrastructure, it is smart to implement techniques to preserve the ecosystem near the coastline – for example, mangroves, barrier islands, coral reefs, sand dunes and forests. These not only help in maintaining the supply chain of fresh air, food, and water but also help in reducing the effects of these natural events on human society by providing enough overspill area and physical barriers or buffers against ocean intrusions and storm damages (Nigel Dudley, Sue Stolton,Alexander Belokurov, Linda Krueger,Nik Lopoukhine, Kathy MacKinnon,Trevor Sandwith and Nik Sekhran 2010).

d) *Mitigation/Adaptation or both:*

Apart from the physical pressure of the human encroachment on the natural ecosystem, another stress that has been disturbing the integrity of the ecosystem is indirect pressure. This indirect pressure is caused by the implementation of policies, management plans, trade and business plans, etc. (Reza 2014). As discussed earlier, any disaster is the measure of human vulnerability to the natural event and it is important to manage this indirect pressure to adapt and mitigate the

human induced changes in the ecosystem (Abramovitz, et al. n.d.). The adaptation policies manage the human societies – construction policies, land-use planning etc., to reduce the impact of natural disaster. Mitigation policies are for the management of the ecosystem, like preserving the forests, coral reefs management, wetland protection etc., to mitigate the effect of the natural event on human settlements.

5.3 Matrix defining the issues of Ecosystem Resiliency:

Ecosystem management involves a number of measures. It includes the physical change, population, biological properties and their interaction with the ecosystem (Reza 2014). The matrix for ecosystem management was created using the issues discussed in previous section. A list of factors were identified addressing those issues using the following documents:

a) *The World bank dataset for climate change* (Bank, Indicators 2015)
b) *Framework for assessing and reporting the ecological conditions by EPA* (EPA 2002)

The frame work of the matrix for ecosystem resiliency looks similar to that of demographic resiliency and physical infrastructure. It is structures as, list of issues, their defining criteria's or their measurement values, and the possible reference source or source for obtaining the data to address those issues. Along with that the matrix consist of four other tabs, which needs to be filled using the planning document of the city to evaluate its resiliency.

Table 5-1 Resiliency matrix for ecosystem management, created by Author

Issues defining resilience of ecosystem	Measurment value	Planning documents of city			Source of information	Possible sources for data availability	Documents referred
		Addressed	Not Addressed	Needs an update			
1) Climatic Change							
a) Extent of Ecosystem	Area					Remote Sensing data	(EPA 2002)
b) Type of Ecosystem	landusedata					Remote Sensing data	(EPA 2002)
c) Land-Use pattern/ Structure	Fragmentation pattern					Remote Sensing data	(EPA 2002)
d) Composition of Ecosystem	Ex: wetland, Marsh, Coral reef					Remote Sensing data	(EPA 2002)
e) % Vegitated land and description	Percentage						
f) % agriculture land	Percentage						(Bank 2015)
g) % rural development	Percentage						(Bank 2015)
h) % urban development	Percentage						

i) Change in ecosystem composition	Percentage						(EPA 2002)
j) Composition of Air	data					Departmet of natural resource	(Bank 2015)
k) CO2 Emission	metric tons per capita					Departmet of natural resource	(Bank 2015)
l) Nitrious oxide emission	metric tons per capita					Departmet of natural resource	(Bank 2015)
m) Methane Emission	metric tons per capita					Departmet of natural resource	(Bank 2015)
n) Green House gas emission (HFC, PFC and SF6)	metric tons per capita					Departmet of natural resource	(Bank 2015)
o) Annual fresh air withdrawal	metric tons per capita					Departmet of natural resource	(Bank 2015)
p) Electric power consumption	kWh per capita					Energy information administration	(Bank 2015)
q) Energy power production	kWh per capita						(EPA 2002)
r) oil consumption	kWh per capita						(Bank 2015)
s) Ground water flow	% impervious surface					land use data	(EPA 2002)
t) water quality							

u) Population growth	annual %					Census data	(Bank 2015)
v) Total population	number					Census data	(Bank 2015)
w) Rural population	% total population					Census data	(Bank 2015)
x) Urban population						Census data	(Bank 2015)
y) Urban growth rate	% increase in grey surface					Smart Grouth America, Measuring Sprawl 2014	(Bank 2015)
2) Effects of climate change							
a) Geomorphological studies	List of major changes					NOAA	(EPA 2002)
b) Change in landscape	% increase or decrease on green cover						(Bank 2015)
c) Change in vegetation type	List of major vegetation before and after						(EPA 2002)
d) Effects in the agricltural production	% chage in agricultural production						(Bank 2015)
e) Change in the natural buffers	% increase or decrease in the size of natural buffer						(EPA 2002)
f) change in precipitation	Annual precipitation in mm						(EPA 2002)
g) Increase in temperature	Rise in temperature						(Bank 2015)
h) Annual sea level rise	in mm						(EPA 2002)

i) change in ground water level	in mm						(EPA 2002)
j) Change in water quality	components and their percentages in the water						(Bank 2015)
k) Different natural events observed	list of events						
l) Frequency of the natural event	Number						(Bank 2015)
m) Intensity of the natural events	distruction caused by event						(Bank 2015)
n) Zone of impact for the natural events	Area effected by the natural event						(EPA 2002)
o) Change in natural buffers	area and types of natural buffers present currently						(EPA 2002)
3) Policies							
a) Land use plans	Document					FEMA	
b) Zoning ordinance	Document					FEMA	
c) Construction standerds	Document					FEMA	(Scott Tezak; David K. Low; Adam Reeder 2009)
d) Clean air act	Document					EPA	(EPA, Air Pollution and the Clean Air Act 2013)
e) Clean water act	Document					EPA	(EPA, Clean Water Act (CWA) Compliance Monitoring 2015)

f) Shoreline protection act	Document					EPA	Shoreland Protection Resources: Clearinghouse for Information on Lakeshore
g) Ecosystem management program	Document					IUCN (International Union of Conservation of Nature)	(IUCN 2014)
h) Green power partnership	Document					EPA	(EPA, Green power Partnership 2015)
i) Heat island reduction initiative	Document					EPA	(EPA, Reducing Urban Heat Islands: Compendium of Strategies 2013)
j) Clean power plan toolbox for state	Document					EPA	(EPA, Clean Power Plan Toolbox for States 2014)
k) Mitigation Ideas: A resource for reducing risk to natural hazards	Document					FEMA	(Baxter, et al. 2013)
l) Coastal mapping	Document					FEMA	(FEMA n.d.)
Total no of issues under in each catagories							

Source: Produced by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA

6. FACTOR IV: SOCIO-ECONOMY

6.1 Introduction

One of the primary measures of the destruction caused by any natural event is the calculation of the total economic loss due to the impact of that natural event. Although that is one of the major points of concern, the microeconomic significance of the problem it could pose on the long-term development, is ignored (Benson and Clay 2004). Also, the disaster is a natural phenomenon but its effects depend upon the circumstances of the location of impact. These circumstances are determined by the conditions of the population in question i.e. poverty rate, critical population and other social factors and their relation to the probable economic impact (Sarah 2004). One of the main aims of this section is to illuminate the importance of the socio-economic impact of the natural disaster, especially their conceptual relation rather than just an empirical calculation. This is because empirical calculation requires normalization and assessment of various factors like physiological stress because of capital loss, profit loss to industries due to shift in capital and many such factors that are difficult to evaluate in a numerical form. Thus it is necessary to describe such factors theoretically to explain the interrelation of economic impact on the demography of the city. The following section will cover the different economic factors and the social issues that are affected by the economic impacts.

6.2 Economic factors

For calculating the economic impact of the disaster event it is important to first understand the two sectors of services supporting to the economy of the city. These two sectors are Public services and private services and are discussed below:

a) **Public services**: These are the services provided by government for the improvement of the people of the city. The tax generated from such services can be used to generate funds for the municipality and the improvement of the city. A fixed percentage of revenue generated by the public services is dedicated towards tax generation. These public services are under the governance of the city government and a number of job opportunities are provided to the public through them. These services and utilities include:

   i. Department of transportation
   ii. Chamber of Commerce
   iii. Environmental agencies
   iv. Department of food and water quality
   v. National guards
   vi. National health services
   vii. Local police department
   viii. Planning department
   ix. Department of energy and resources
   x. Communication departments
   xi. Department of agriculture
   xii. Department of justice

xiii. Public service department

xiv. Cultural resource management

xv. Land-use department

xvi. Postal service

xvii. Construction

xviii. Board of Education

xix. Waste management

xx. Social services

xxi. Public housing

xxii. Library

xxiii. Fire services

xxiv. Emergency management services

xxv. Water supply department

Any services managed by local government for public use fall under this category. The list of activities is more extensive than mentioned above, but it is only meant to give a generalized idea of the scope of services considered public.

Private Services: Private sector includes the investments made by private enterprises, which contribute to the tremendous growth of the city. These investments provide many infrastructural services, job opportunities, improvement in health and education systems and many more basic services like grocery stores, hotels, pharmacies etc. The tax revenue generated by such services is utilized for maintaining and improving public infrastructure and also as backup funds in case of a natural disaster (Bank, Private Sector 2015). The private and public sectors are inter-related because the services provided by the public sector are

important for the functioning and maintaining the standard of private infrastructure. Thus public-private partnerships are really important for creating a resilient economy after the natural events. Following is the list of a few basic private sector services available in a city (state 2010):

i. Restaurants
ii. Grocery stores
iii. Visitor centers
iv. Bars and pubs
v. Local businesses
vi. Tourism centers
vii. Hospitals
viii. Schools
ix. Transportation services
x. Medical stores
xi. Laundromats
xii. Insurance agencies
xiii. Construction agencies
xiv. Cleaning agencies
xv. Agricultural agencies
xvi. Local markets

Disturbance in the social factor due to a natural event causes economic damages in the city because of imbalance in the functioning of the system. The next section will explain different layers in which social disturbance can cause the economic imbalance.

6.3 Social imbalance and its economic impact

As discussed above, it is difficult to measure the impact of social imbalance on the economic supply system of the city. Therefore, in this section I will be discussing this impact theoretically to emphasis and understand this interdependence:

a) **Population shift:** Population shift is one of the major concerns for the socio-economic stability of the city after a natural disaster. Since population helps in boosting the economic growth of the city (Kiguru, Thuku and Almadi 2013), the population shift due to any natural event can be both temporary and permanent and will have two economic impacts. Firstly, because of the sudden population shift, the existing public services will lose customers and hence the profit, which will result in migration of the local private businesses and services to the city center. Secondly, due to the movement of more and more people and private services towards the center of city, there would arise, a sudden requirement for additional infrastructure to support the newly migrated population (which would require further tax money to upgrade its infrastructure, on top of the rehabilitation and cleanup costs, post disaster). This sudden additional cost might cause the economy to crash.

b) Source of Income for the city: Sudden migration of population after the natural disaster can (in many cases, especially in coastal cities) affect the main revenue generating activities and food supply networks like tourism, agriculture etc. This can not only cause the economic crisis but also disturb the food supply network of the system.

c) **Critical population:** One of the important after-effects of any natural disaster is the increase in the critical population, which may increase the investment on coverage provided by the government for their health and basic daily needs.

d) **Infrastructure failure:** Because of sudden migration of population, the existing infrastructure like gas, power supply, water supply become insufficient to support the migrated population, causing failure.

e) **Increase/emergence of special facilities:** A lot of the times, after the disaster, due to migration of population and private services, the government has an opportunity to develop the impact site for special tourist activities or preservation sites that are maintained and operated by government to generate greater revenue from the location by using the existing infrastructure.

f) **Psychological Impact:** This is another non-measurable and unpredicted social aspect that can affect the economy of the city. This can cause emotional instability and focus issues, which can reduce the productivity in the economic sector.

Since the socio-economic aspect has recently been noted and considered as an important factor to be addressed, there is not a lot of research done to properly measure its impacts. Some research done by Susan Cutter and other researchers and writers is conflicting in itself. It is therefore, difficult to create a list of issues for identifying and measuring the socio-economic resiliency of a city from natural disaster. But there are methods proposed by Susan Cutter in the paper *"Revealing the vulnerability of people and place: A case study of Georgetown county, South Carolina"*, which require the identification of important activities and the social dependency on such activities. The next step is to calculate the social vulnerability to normalize that dependency rate by the total number of activities present in

the city and their usability. This process of normalizing will provide a ratio, which can help in identifying the most critical infrastructure, from the social dependency point of view. But none of these calculations have considered the physiological factors post-disaster which can affect the functioning of the city (Cutter, Mitchell and Scott 2000). Another method has been adopted by the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC), in a research conducted on *"Nicaragua: Assessment of the damage caused by hurricane Mitch, 1998: Implications for economic and social development and for the environment"*. The methodology of the research includes the identification of both direct and indirect impacts of the disaster. Direct impact includes physical loss of property, infrastructure, etc. and indirect impact includes the loss of productivity and the flow of activities. The direct impact is calculated with the data for the direct impact measurement i.e. loss in property value, stocks etc. The indirect impact i.e. the socio-economic impact, was calculated by dividing the damages into different sectors, like infrastructural, economic, social etc. and their effects was studies in the form of public and private sectors and their cross-sectional impact on the other sections too (ECLAC 1999). Another counter argument on this research and evaluation theories is provided by Suman K. Sharma in the research, *"Socio-Economic Aspects of Disaster's Impact: An Assessment of Databases and Methodologies"*. The argument suggests that it is difficult to evaluate the socio-economic impacts by quantitative methods; rather it can be explained through literature by understanding the social dependencies on the economic structure of the city. Few of the reasons supporting the arguments were, firstly, the data issue. This explains the probability of misuse of the term "Disaster" and "Hurricane" while collecting the data, availability of the reliable base line data for normalizing the calculation, shortage or missing data, no standard

data collection process, the scale of data collection etc. Other issues identified in the literature are the difficulties in disaster impact assessment, i.e. measuring the post disaster impact caused due to disturbance in ownership structure or physiological impact, etc. (K 2010).

Since the economists and socialists have recently considered the socio-economic issues, an impact of natural disasters, there is not much research is available about the issues and methods for measuring the resilience toward them. Hence, it is difficult to create a matrix for such issues, but the classification identified above can help in understanding the long-term social impact on the economy of the city after the natural event. The following diagrams explains the same in the form of vector diagrams.

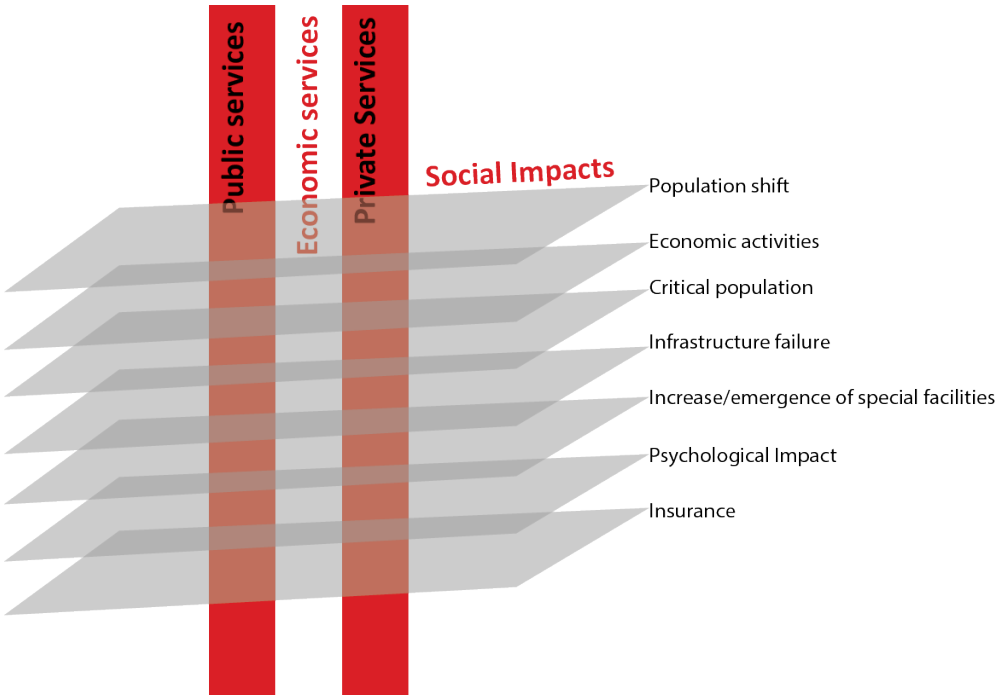


Figure 6-1 A model for explaining socio-economic interdependencies

7. APPLICATION OF RESILIENCY MATRIX

7.1 Introduction

So far, this practicum was concerned only with the identification of major factors and their variables used for measuring the resilience of natural disaster for coastal events (specifically). This section of the practicum will be utilizing those set of issues identified by reviewing different articles and research done by writers, practitioners, reviewers etc., to measure the resiliency of a coastal city in Georgia. This is done firstly to test the applicability of the matrix and also to measure the resiliency of the policies and mitigation plans of the coastal cities for any natural event. To achieve this, the structure and presumptions of different planning documents and mitigation plans will be tested on the basis of the issues identified by literature studies. Once the documents have been verified by the matrix, the exact incomplete portion of the documents can be identified for completion or updates. The updates in the document can be done with reference to the planning documents of Florida. According to a study done by the American Planning Association (APA), Florida was one of the initial 10 states that mandated comprehensive planning and had an updated post disaster recovery plan included in their comprehensive plan (mandated for coastal cities) (APA 2014). The other option for updating the missing portion of the plans is by using the available sources listed for getting information about that particular section.

The next section of the discussion is to explain the process of selecting a city in the state of Georgia for testing the matrix and a similar city in Florida (to use as a reference document for updating the plans of Georgia). Moreover, it would be interesting to see if the planning

document does make the city as resilient at it seems to be, by testing its document with the created resilience matrix.

7.2 Why Georgia and Florida.

According to the Multi Hazard Mitigation Plan Status by FEMA (FEMA, Multi-Hazard Mitigation Plan Status 2014), there are only 11 states in the country with FEMA approved enhanced state mitigation plans, which include North-Carolina, Georgia and Florida. But only Florida and North Carolina have mandated them to the coastal cities and Florida is the only state with the post-disaster recovery element included in its comprehensive plans (FEMA, Introduction to the long-term community recovery 2005). Although Georgia has a statewide hazard mitigation element in the plans, it has not quite been adopted by the cities in their comprehensive plans. Since Georgia has a luxury of a specific geographical location called Georgia Bight and the proximity of the Gulf Stream called “Bermuda High” or “Azores High”, the state is protected from the Atlantic based current. Georgia is also protected by a series of barrier islands and marshlands, which provide sufficient overspill area and protection from long distance tidal waves. Due to these geographical advantages, Georgia has not been impacted by a major hurricane since 1959 (hurricane David) (Terri 2013). But a constant increase in sea-level is posing problems like subsidence of land mass, beach erosion, salt water intrusion, etc. affecting the natural barriers from the storm event and increasing the probability of floods and hurricanes. These favorable conditions and an increase in migration will also augment the population growth by 51% since the year 2000 (prediction) (Technology 2006). Thus, there is an immediate need to update the planning documents of Georgian coastal cities for disaster risk management. Since Georgia and Florida are located next to each other, I have selected a city from Georgia and Florida to test

the resiliency matrix on them. The process of selection of cities is explained in the next section. Once the matrix has been tested on both the cities, successful solutions can be adopted and implemented for the missing or incomplete sections of the planning document to make it more resilient-supportive.

7.3 Process of selecting the cities:

The process of selecting a city in Georgia and Florida involved overlapping some basic data, and finding a city with the overlap of all considered factors in both the states. The criteria are described below:

a) Setting up a time line for research (since 2000 to current): Sudden increase in population since the year 2000 i.e. 13% approximately as compared to 1900 to 2000, which was 9.8% (Bureau 2010).
b) Number of natural events observed in the study area during that time period: To predict the intensity of the natural events
c) Types of natural events observed in the study area
d) Area of the coastal cities: To calculate the economic impact of the natural event
e) Total population of each city: To calculate the social impact of the natural event
f) Population density
g) Port city: To understand the development pattern and the possible economic damage
h) Tourist destination: To consider the floating population of the city.

For the analysis all the cities were arranged from the city with the greatest area to the city with the smallest area as defines by the governmental boundaries. This graph of cites was then overlapped with other layers of total population, no. of disaster events, tourism and port

cities to create the vulnerability graph for Georgia and Florida. Figure 7-1 and 7-2 shows the vulnerability graph of Georgia and Florida.

Vulnerability graph for coastal Georgia

AREA

Figure 7-1 Vulnerability graph for coastal Georgia

The above graph shows that the Savannah is the only city in the coastal counties of Georgia with the all five overlapping factors. So for testing the implementation of the resilience matrix that was created in the previous chapters Savannah from Georgia was selected. Next few set of figures show the vulnerability graph of Coastal cities of Florida. Since the state had 276 coastal cities in total, therefore the graph has been split in to four parts for the purpose of fitting it in the format of the document.

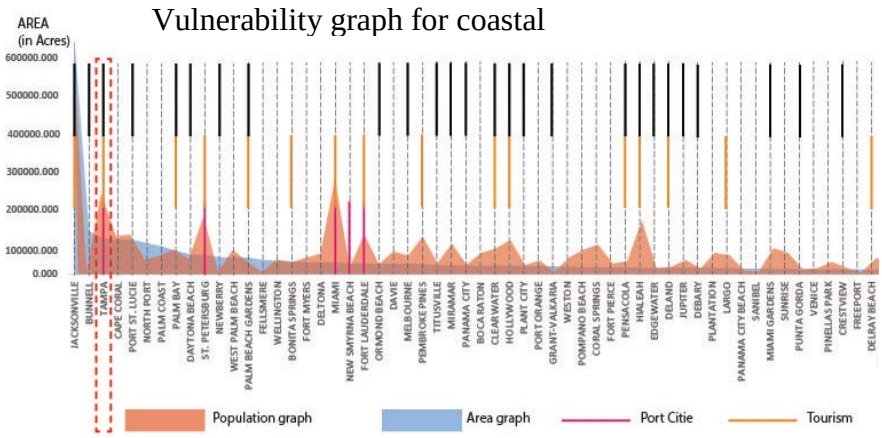


Figure 7-2 Vulnerability graph for coastal Florida

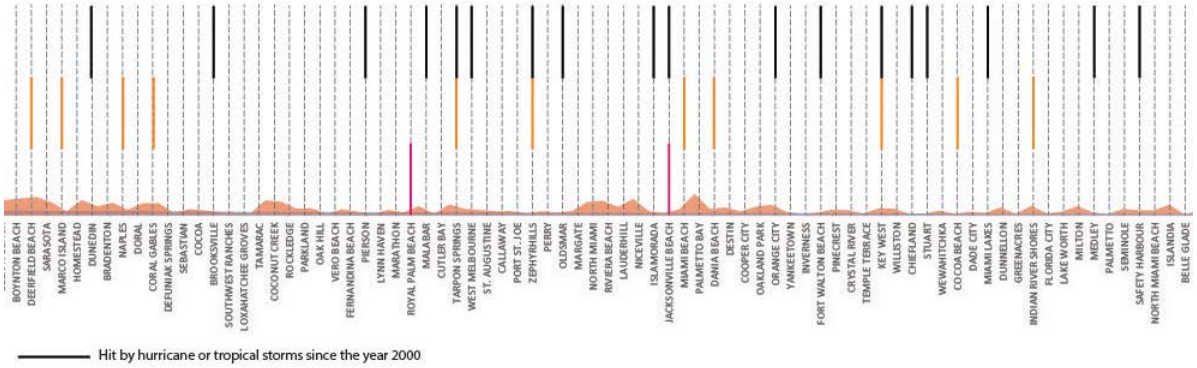


Figure 7-3 Vulnerability graph for coastal Florida (Con.)

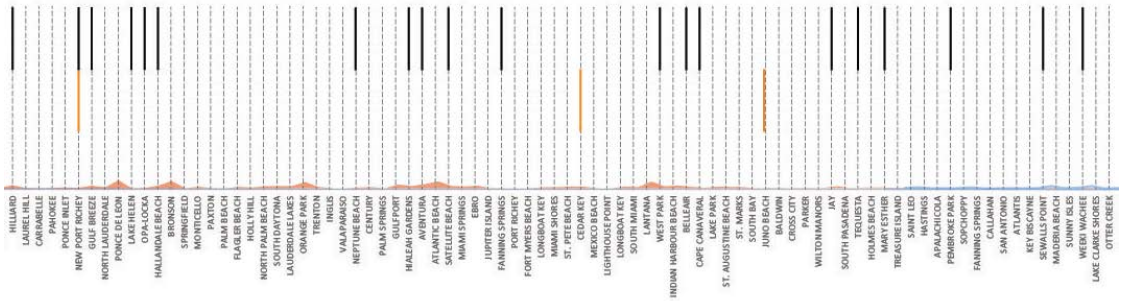


Figure 7-4 Vulnerability graph for coastal Florida (Con.)

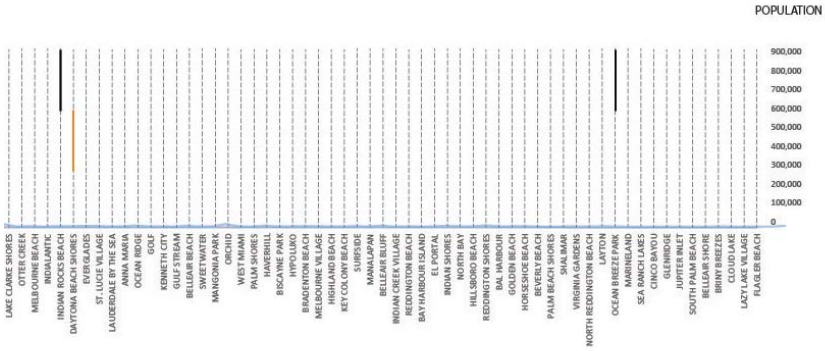


Figure 7-5 Vulnerability graph for coastal Florida (Con.)

The set of figure shows the vulnerability graph of coastal cities of Florida. Out of 276 cities, only two cities have the overlap of all five features which are Tampa and Jacksonville. The next section will be discussing the reasons for selecting the one city out of two for comparing and testing the applicability of the resiliency matrix.

7.3.2 Selection criteria between Tampa and Jacksonville:

The following table explains the comparison between three cities. The purpose of the comparison is to come up with a valid argument for selecting two similar cities and applying the resiliency matrix on both of the so as the missing portions of one can be completed by adopting the solution from other or by the other available resource listed in the matrix.

Table 7-1 Comparison between Savannah Jacksonville and Tampa

Criteria's	Savanah	Jacksonville	Tampa
a) Receives the Atlantic Ocean Current	✓	✓	
b) Receives the Gulf current			✓
c) Protected by marshland and barrier islands	✓	✓	✓
d) Affected by Georgia bite	✓	✓	
e) Largest city of the state	✓	✓	
f) Largest port city of the state	✓	✓	
g) River flow through the city	✓	✓	

h) Affected by hot water current of "Azores high"	✓	✓	
i) Elevation	49' above sea level	16' above sea level	48' above sea level

Table 1 shows the criteria's of comparison between three cities i.e. Savannah, Jacksonville and Tampa. The table was created to understand the similarities between the city of Savannah and one city for Florida so that the planning solutions from one will be valid for other too. As a result of above table Savannah and Jacksonville seems to be more comparable cities than Savannah and Tampa. The reason being, not only they both faces the Atlantic current, but also are affected by the presence of the geographical feature called "Georgia Bight" and hot water current generated by the Azores High/ Bermuda High. The Figure 6 shows the location of Georgia Bight which starts from Cape Fear, North Carolina and span till Cape Canaveral, FL. The location of Savannah is almost at the center of Bight and Jacksonville is a little further south. The impact of presence of Azores High diverts the Westerly winds because of the low pressure zones created on top of it, thus, diverting the tropical winds towards the South Atlantic region. These tropical wind cause high tidal Atlantic waves to hit the south

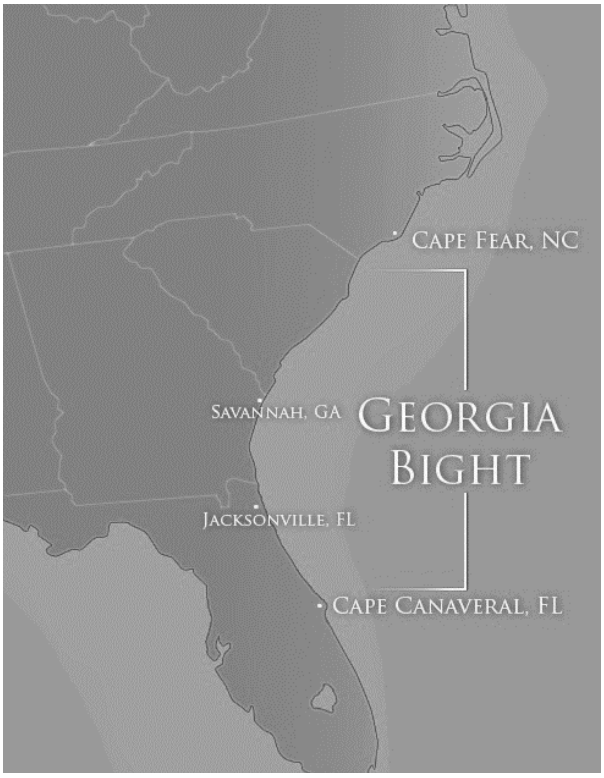


Figure 7-6 Georgia Bight. Source: University of Georgia, Georgia Sea Grant: About Georgia Coast

eastern part of the United States. Because of these tidal waves, the water makes it way towards the center of Bight along the coast causing a funneling effect towards the center of the Bight and thus cause the accumulation of water and increase in elevation. This causes a problem of constant flooding in these area with the tidal waves as big as six to ten feet twice a day (Grant n.d.). Since both City of Savannah, GA and Jacksonville, FL have a similar geography, climate and city structure, it would be easy to compare them and adopt solution applicable on one for the other.

In the next section I will be testing the application of the resiliency matrix on Savannah and Jacksonville. The purpose of this application is firstly to understand how resilient the cities are (by assigning 1 point to each issue in the matrix) and secondly, to identify the particular section in the planning and hazard mitigation documents that need to be immediately updated for a better management and response for the disaster situation.

7.4 Application of resiliency matrix on Savannah GA and Jacksonville FL

7.4.1 Application of the Resiliency Matrix on the Planning Documents of Savannah, GA:

City of Savannah was founded in 1733 by colonist James Edward Oglethorpe and is the oldest city in Georgia (Buddy 2014). The total land area of the city is 103 square miles with a total population of 136,286. It is locates in the south eastern Georgia at the Georgia- South Carolina border were the Savannah River and the Atlantic Ocean are the natural boundaries of both the city and state (City-Data.com 2009), (Savannah, City of Savannah DRAFT flood mitigation Plan 2015).Georgia have been lucky enough to avoid all those hurricanes because of its location that’s far west in the South east Atlantic region and also have a fewer miles of coast line as compare to the Florida or South Carolina, makes it difficult for direct hit. But this doesn’t mean the state doesn’t have to be prepared for the disaster. Because of the

indented coastline, when the tidal waves hit the south Atlantic region, the water make its way towards the center of the indentation, result in increased flooding problem in savannah.

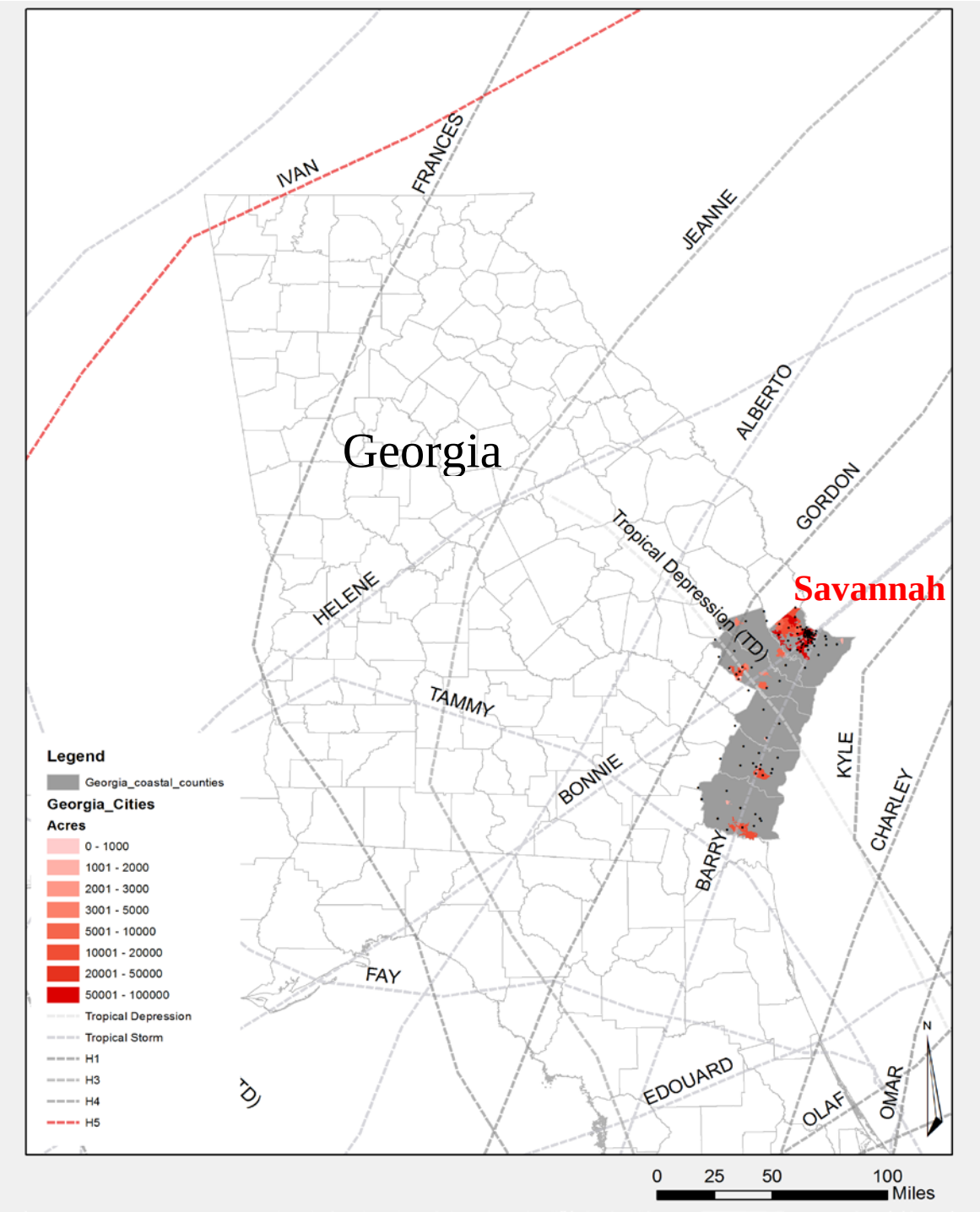


Figure 7-7 Map showing the coastal cities and counties for the state of Georgia

Thus in order to test the resiliency of cities planning document toward there recurring issues, the matrix was applied on it. As discussed in previous chapter the resiliency matrix was created considering the demographic, infrastructure, ecological and socioeconomic factors. The planning document of city will be tested on the basis of all those factors and how well they have been addressed in the documents. At the end 1 point will be assigned to each criteria's of the issues defining the resiliency for the city. On the basis of those points the resiliency score will be calculated for the city.

Demographic resiliency for Savannah

The City of Savannah have a total population of 142,772 residence as per the 2013 US Census data which is 7% increase from 2000 census and 4.7% increase from 2010 population. As a result of Sea Pine development prototype in Beaufort County, South Carolina, which is adjacent to the Chatham County in 1980's there was a dramatic development in the Chatham County. Resulting is a sudden population boom in the year 2000 (and has been increasing after since). To accommodate this rising population, more affordable housing was constructed and the inlands were developed. The historic properties of downtown Savannah were restored and developed for enhancing the touristic sits, resulting in further boon in touristic population and new residence in Savannah. Another development brought in by Sea Pine development was the development of multiple Golf course. Savannah itself have 3 Golf course within the city, attracting the settlement of retires in the city. Also along with the pleasant environment and historic values, the city provides affordable housing and tax exemptions for the retirees, attracting more and more elder population in the city. Also the availability of affordable housing attracted the immigrant population (Commission 2004). All these factor increases the demographic vulnerability of

the city towards any natural event. Thus to test the demographic resiliency of the planning document for the diverse group of population available in the city of Savannah, the resiliency matrix is applied to it. The issues mentioned in the matrix cover the population type of all age group, ethnicity, income level and critical condition of the population. The matrix is to make sure that sufficient policies have been outlined in the planning documents for preventing and mitigating the damages caused by the natural event to the population type. Next is the resiliency matrix for the demographic resiliency showing the issues, available documents to address those issue and the missing portions of the document.

Table 7-2 Demographic Resiliency for City of Savannah GA

Issues of Demographic Resilience	Measurment value	Planning document of Savannah			Source of information	Possible sources for data availability
		Addresssed	Not Addressed	Needs an update		
1) Geographical location						
a) Location	Proximity to a natural disaster	✓			Savannah Flood Management Planning: Section 3, Hazard Identification and Analysis	USGA Geological data
b) Type of natural disaster	Intensity of the disaster type	✓			Savannah Flood Management Planning: Section 3, Hazard Identification and Analysis	National Weather Services- For hurricane path National elevation data- For Sea level rise
c) Estimated boundar or distruction by natural disaster	Path of hurricane or Area under sea level rise	✓			*Savannah, Flood Insurance rate map (FIRM) * SLOSH model calculations for Chatham County	National Weather Service/ National Hurricane Center
d) % Area of city under the estimated boundary of natural disaster (ex: area under 3ft sea level rise)	Area ratio	✓			SLOSH model calculations for Chatham County	GIS mapping (overlapping the layers of total area of city and area under estimated boundary of natural disaster)
2) Census data						
a) Total population of city	Total no. of peoples	✓			Savannah Flood Management Planning: Section 3, Hazard Identification and Analysis	United state census bureau

b) Estimated population growth	Percentage of population growth in the city in next 10 years	✓			Georgia Coaast 2030: Population projections for the 10 county coastal region	US census bureau-Population projection
c) Population types:						
i) Population under age of 5 years	Percentage of population	✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	US census bureau
ii) Population under age group of 18 years	Percentage of population	✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	US census bureau
iii) Population of age 65 years and above	Percentage of population	✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	US census bureau
d) Percentage of population under the estimated hazard zone	Percentage of population	✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	
e) Percentage of critical population under the estimated hazarad zone		✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	
i) Percentage of elderly population		✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	
ii) Population under age group of 18-65 years		✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	

iii) Population in age group of 18 years and below		✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	
f) Percentage of population suffering from an chronic disease	Percentage of population	✓			Savannah/ Chatham County Region Health Disparities Data (http://linux.savannahstate.edu/rimiresearch/rimi_002.htm)	Center for Disease Controle, State Profile
g) Location of medical centers	Locational maps and accessibility data	✓			Savannah Flood Management Planning: Section 4, Vulnarability Assessment	State clearing house, GIS Data
h) Critical facilities provided in the hospitals in case of emergency	list of facilities			✓	First health of the carolinas Chatham County	Individual hospital website/ Survey
I) Backup plans for the hospital and other medical facilities				✓	First health of the carolinas Chatham County	
j) Race and Ethinicity	Percentage of population types	✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	US Census data
k) Percentage of population of womens	Percentage	✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	US Census data
m) Education levels	Percentage of populaton	✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	US Census data
i) percentage of population with secondary education		✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	US Census data
ii) percentage of population with high-secondary education		✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	US Census data

ii) percentage of population with college education		✓			Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	US Census data
n) Education and outreach programs for the possibel disaster events and saftey measures	Document	✓			Chatham County Multi-Jurisdiction pre-disaster hazard mitigation plan	
o) Location of Emergency shelters	Maps showing the possible location of shelters			✓	Chatham County Multi-Jurisdiction pre-disaster hazard mitigation plan	
p) Approximate capacity of the emergency shelters	Percentage of population its accomodating			✓	Chatham County Multi-Jurisdiction pre-disaster hazard mitigation plan	State mass care shelter program, and Center for disease controle
q) Child care centers	List of all the child care centers			✓	Emergency Care Services at St. Joseph's/Candler	State mass care shelter program, and Center for disease controle
r) Pet rescue plans	list of agencies that would be involved in pet rescue plans	✓			Planning (Chatham Emergency Management Agency)	Federal Pets Evacuation and Transportation Standards (PETS)
s) Emergency management plans for food supply, fresh water and electricity	List of agencies that would be involved			✓	Chatham County Disaster supply kit and Planning Tip	Center for disease controle, Fedral Emergency Management Plans
t) Evacuation plans	List of agencies involved and detail discription for the plan	✓			Chatham Emergency management agency , Hurricane Evacuation , shelter and transportation brochure	FEMA Evacuation Liaison team, Fedral highway administration, State Department of Transportation
u) Types of Business	List of all the different types of bussiness and their economic gains	✓			Chatham County Hazard Mitigation Plan	State department of economics
v) Potential economic loss after disaster	percentage of bussiness under the estimated hazard zone	✓			Chatham County Hazard Mitigation Plan	State GIS Clearing house, Tax assessors office
w) Tourist evacuation plan	Document		✓			FEMA- Developing and Maintaing Emergency operation plans
3) Hazard Mitigation plans for people						
a) Understanding the type of hazard	Document	✓			Savannah Flood Management Planning: Section 3, Hazard Identification and Analysis	

i) Previous disaster caused by similar disaster		✓			Savannah Flood Management Planning: Section 3, Hazard Identification and Analysis	
ii) Awareness programs		✓			Chatham County Multi-Jurisdiction pre-disaster hazard mitigation plan	
b) Types of Infrastructure under risk of hazard	Percentage of each type of infrastructure	✓			Savannah Flood Management Planning: Section 4, Vulnarability Assessment	County GIS Data
i) Industrial						
ii) Corporate						
iii) Residiential						
iv) Highways						
v) Electrical grids						
vi) Ports						
c) Property valuation report to understand the risk associated with it at different geogrphical locations.	Document	✓			*Savannah Flood Management Planning: Section 4, Vulnarability Assessment * City of Savannah property tax	Tax assessors office
d) Building Construction standerds	List of standerds			✓	City of Savannah: Standerd construction detail	FEMA- Home Builder's Guide for Coastal Construction
e) Insurance policies for building in the estimated range of hazard	Special rates for flood insurance of properties under the flood zone or ther natural hazard			✓	Savannah Flood Management Planning: Section 7, Mitgation Action Plan	Home owener's Guide, Flood insurance rate map for states
f) Critical hotspot mapping for econimic center	Percentage of the critical infrastructure for economical center under the estimated hazard zone	✓			Savannah Flood Management Planning: Section 4, Vulnarability Assessment	GIS data for business
g) Awareness programs for :			✓			
i) The disaster relief programs	Document					
ii) Proparty insurance programs	Document					
iii) Health insurance program	Document					
iv) Disaster recovery programs	Document					
h) Reocation plan for critical infrastructure and econic center, in the hazard zone	Document type with phase plans for relocation		✓			
4) Management of critical population						
a) Percentage of Elderly population in city	Percentage of population	✓			Coastal Regional Commission: The Area Agency on Aging	US Census data

b) Percentage of Elderly population with a chronic disease	Percentage of population			✓	Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	Center for Disease Controle, State profile
c) Percentage of population under poverty line	Percentage of population			✓	*City data.com/ Chatham County (http://www.city-data.com/county/Chatham_County-GA.html) * US Census Data/ Chatham County (http://quickfacts.census.gov/qfd/states/13/13051.html)	US Census data
d) Medical facilities and supply centers for population with chronic disease	Document	✓			Coastal Regional Commission: The Area Agency on Aging	Center for Disease Controle
e) Special evacuation facility for critical population	Document			✓	Tricentennial Plan, Chatham County-Savannah Comprehensive Assessment Report	Department of health and human services, FEMA
f) Food suply and temporary accomodation facility, especially for peoples under poverty line	Document			✓	Chatham County Multi-Jurisdiction pre-disaster hazard mitigation plan	National disaster housing stratagies FEMA, Emergency Support function, FEMA and Department of homeland security
g) Earlier evacuation facilities for critical population	Document		✓			Florida Department of Health, Hospital evacuation tool kit
h) Facilities for low rate insurance policy for population under poverty line	Document					
i) For property			✓			
ii) For health			✓			
i) Special educationa and outreach program for population under poverty line and eldarly population to avoid property fraud, and exploitation after disater	Document	✓			Coastal Regional Commission: The Area Agency on Aging	Community eduction and outreach FEMA
Total no of issues under in each catagories		**36**	**6**	**12**		
Source: Produces by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA 2015						

Table 7-2 above shows the application of the matrix to calculate the demographic resiliency for the city of Savannah GA. As discussed in the beginning of this section, by assigning 1 point to each issues identified in the document for testing the demographic resiliency for the planning documents, it has successfully addressed 36 of the 54 issues in the documents. A list of document is also identified in the table stating which document have the issues addressed in it. 12 of the 54 issues needs an update in terms of how well it has be discussed in the documents and how it is compiled in their hazard mitigation guidelines. 6 of the 54 issues are missing or still need to be addressed in their mitigation plans for natural hazards like flood sea- level rise and hurricanes. Following are those issues that need immediate attention:

a) ***Tourist Evacuation Plans***
b) ***Outlining a well-defined education and outreach programs for the local communities, for guiding them about the possible damage caused due to disaster and how to recover from them.***
c) ***Phasing plans for the relocation of the critical infrastructure and the economic center from the hazard zone, that can reduce the immediate financial burden from the population***
d) ***Earlier evacuation plans for the critical population (i.e population above 65 years of age, below 5 years of age, population with a chronic disease and physically disables) to reduce the loss of life.***
e) ***Low insurance rate or better insurance coverage for health and property for the population under poverty, so that everyone can afford it.***
f) ***Special education and outreach program for critical population and uneducated population group of the city.***

The solution for these missing links for the demographic resiliency can either be pulled out from the planning suggestions implemented in the neighboring counties having similar issues (in this case Jacksonville, FL) or from the suggested document (in the excel sheet) available on the similar topic.

Resiliency of urban infrastructure for Savannah

As described earlier, the urban infrastructure for a city can be defined under physical and organizational infrastructure. For city of Savannah as the development boom started in 1980's, to accommodate the migrating population construction of affordable housing started. Combined with the development of bedroom communities, it was established as a center of trade and commerce. In fact when rest of the county was affected by the decline in manufacturing, there was an increase in imports from the port of Savannah. Also another important connection between Fort Stewart in Bryan and Liberty Counties, Hunter Army Airfield in Chatham County, and the Georgia Ports Authority, through deep water port, direct rail and limited access highway, further open up the possibility of transportation (Commission 2004). Savannah's and Brunswick's deep water port are Georgia's gateway to the world. They are the critical conduits through which raw material and finished products are imported and exported to the world. The port of Savannah is also the home to the largest single-terminal container facility of its kind in North America, is comprised of two modern, deep water terminals: Garden City Terminal and Ocean Terminal (Authority 2013). Also there was a major change in the economy of the city was when manufacturing economy was replaced by service economy, which gave rise to the services like, health and medical facilities, retail, hospitality, insurance, banking, advertising etc. Thus all these changes and development required the construction of physical infrastructure for its functioning. This

growth in city increased it vulnerability to any natural event, by increasing the actual loss in monetary value to these structure, plus the projected loss to the economy of the city due to the failure of the infrastructure. Thus it is important to insure the resiliency of these physical infrastructure and the organizational infrastructure (includes the laws, sanders and actions governing different activities of the city) to mitigate the impact of the natural event. Thus the matrix defined below for physical and organizational infrastructure can be used to insure the resiliency of the same.

The issues defines in the resiliency matrix for physical infrastructure were identified in order to understand the types of critical infrastructure present in the city and amount of economic loss that can be cause because of damage to those structure and physical conditions of the structure. The scoring pattern to evaluate the resiliency of the physical infrastructure is similar to that adopted in the demographic part discussed earlier in this section.

Table 7-3 Resiliency of Physical Infrastructure for Savannah, GA

Issues of Resilience in physical infrastructure	Measurment value	Planning document of Savannah			Source of information	Possible sources for data availability	Documents referred
		Addresssed	Not Addressed	Needs an update			
1) Nature of natural event							
a) Type of natural disaster	List of disaster events place is suceptable to (study from history of the place)	✓			Chatham County Multi- Jurisdiction pre-Disaster Hazard Mitigation Plan 2010	NOAA national weather service, Office of climate, water and weather services	(Oh, et al. 2013), (Cutter, Mitchell and Scott 2000),
b) Frequency of natural disaster	(No. of events x 100) ÷ (No. of years)	✓			Chatham County Multi- Jurisdiction pre-Disaster Hazard Mitigation Plan 2010	FEMA, national reaserch council, local news sources	Cutter, Mitchell and Scott 2000
c) Zone of impact of natural disaster	mapping the area of impact for natural disaster	✓			Chatham County Multi- Jurisdiction pre-Disaster Hazard Mitigation Plan 2010	NOAA GIA data for hurricane, FEMA floof map	Cutter, Susan L., Bryan J. Boruff, and Lynn W. Shirley. 2003, Cutter, Mitchell and Scott 2000

d) Forms of impact caused by the natural event	Distruction caused throurh water, gas, or solid	✓			* Draft repetitive loss area analysis. City of Savannah, Georgia, Development Services Department * Chatham County Multi- Jurisdiction pre-Disaster Hazard Mitigation Plan 2010	Study of different types of natural disaster	Lindell, Michael K., and Carla S. Parter. 2003
2) Identification of Critical Infrastructure							
a) identification of frequently used infrastructure	Interviews from local public	✓			Chatham County Multi- Jurisdiction pre-Disaster Hazard Mitigation Plan 2010	Interviews and local comminity data	Oh, et al. 2013
b) Comparing it with the list of critical infrastructure identified by CRS, FEMA, ASCE	list of data already identified before	✓			Chatham County Multi- Jurisdiction pre-Disaster Hazard Mitigation Plan 2010	*2013 report card for America's Infrastructure.* American Society of Civil Engineering; Critical infrastructure and key resources support annex. Fedral	Moteff, John, and Paul Parfomak. 2004; Oh, Eun Ho, Abhijeet Deshmukh, Makarand Hastak, and
c) Normalizing the identified infrasyructure as per their social and economic contribution	Interviews of the people as per the usage of the infrastructure	✓			Chatham County Multi- Jurisdiction pre-Disaster Hazard Mitigation Plan 2010	Inputs from local government and citizens	Oh, et al. 2013
d) Calculating the impact of few major infrastructure:							
i) Electricity	Calculating the social and economic impact of power outage			✓	Office of infrastructure protection- Savannah Area Hurricane Analysis Summary, NISAC, US Department of Homland Security		Oh, et al. 2013

ii) water	Calculating activities dependent on water supply		✓				Oh, et al. 2013
iii) road	Identifying the important road network and its supporting population	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	State Department of transportation	Oh, et al. 2013
e) Mapping of the identified critical infrastructure in the hazard impact zone	Map showing the location of infrastructure	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	Local researchers	Lindell, Michael K., and Carla S. Parter. 2003
f) Evaluating the physiscal condition of the critical ifrastructures	Report			✓	Cannot find the evauation report but was used in a section of City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015) as per the Annex	American society of civil engineers, state chapters	ASCE. 2013. *2013 report card for America's Infrastructure*
3) Regulations for maintaining the critical infrastructures							
a) Funds and policies for improving the conditions of critical infrastructures	Report	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	Water supply improvement program (WSIP), Pre-Disaster Mitigation Funds (PDM) From FEMA, Beach Act by Enviormental protection Agency, Clear water state revolving funds, etc.	ASCE. 2013. *2013 report card for America's Infrastructure*
b) Construction and improvemnet standerds (for existing structures) for critical infrastructures	Report	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	FEMA building construction coads	FEMA. 2005.Summary of Coastal Construction Requirnment and Recommendatio n

c) Insurance policies for the critical infrastructure	Report	✓			Chatham County Georgia, Flood insurance study		
d) Phasing of the relocation policies for the critical infrastructure.	Report			✓	Compling with CRS Activity 520; City of Savannah DRAFT Floodplain Mitigation Plan		
e) Identification of the critical population group associated with the critical infrastructure	Report	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)		
f) Special health care facilities for the critical population during the time of natural disaster	Report		✓				
g) Programs for alternative way of communication during the disaster conditions	Program and product development	✓			Georgia's Public Broadcast Systems are Peach State Public Radio and Georgia Public Television; Georgia Public Television	Cell on wheels program	(Jha, Miner and Zuzana 2013)
Total no of issues under in each catagories		**14**	**2**	**3**			
Source: Produces by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA 2015							

Table 3 shows the resilience matrix of physical infrastructure for the city of Savannah. Out of 19 issues identified in this research for the resiliency of the physical infrastructure, Savannah has successfully addressed 14 of them in their planning documents. 3 issues needs to be properly discussed and compiled on the hazard mitigation plans and the comprehensive plans of the city. 2 issues out of 19 were not found or seems to be addressed in most of the planning document and might need some attention to avoid any major economic loss in the city due to natural event. Those un-addressed issues are:

a) ***Calculating the impact of flooding, sea level rice and hurricane on the water quality and the fresh water infrastructure***

b) ***Management and provision of special health care facilities for the critical population during the time of disaster and right after that.***

Again these missing links for the resiliency of the physical infrastructure can be complete using the solutions adopted by Jacksonville FL, or using the other available resources (listed in the matrix) on the similar subject.

Next is the matrix for the Organizational infrastructure for the city of Savannah. The Construction of this matrix is a little bit different from the previous two. This matrix was divided into 4 phases' mitigation, preparedness, response, and recovery. The matrix shows the list of documents city of Savannah is complying to address the issue of organizational resiliency. For the issues that are states under "needs an update", means the city has identified and referred the government agencies and related document but it is not officially stated in their hazard management plans.

Table 7-4 Resiliency matrix of Organizational infrastructure for the city of Savannah, GA

Phases of organizational structure	Agencies involved	Guides provided by agencies and researchers	Planning documents of Savannah			Source of information	Documents referred
			Implemented	Not Implemented	Needs an update		
1) Mitaigation plan							
a) Risk Assessment	*FEMA (Fedral emergency management Agency)*	National Hurricane Center				City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	(Jha, Miner and Zuzana 2013); (Oh, et al. 2013)
		Historical Hurricane Tracks					
		FEMA flood hazard mapping	✓				

		National Geophysical Data Center					
		National water and climate center					
		National climatic data center					
		National hazards center					
		Flood map service center	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
		Floods and Flash Floods Information					
		FEMA national flood hazard layer	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
		FEMA, HAZUS-MH Software	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
	USGS (United States Geological Survey)	National Flood frequency Program					
		USGS Natural Hazard Gateway					
	NASA (National Aeronautics and Space Administration)	Global Flood hazard frecquency and distribution					
	NOAA (National Oceanic and atmospheric administration)	NOAA Coastal Service Center					
		Weather Saftey and Preparedness Brochures	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
	Arc GIS (Geographic information system)	Flood frequency class mapping	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
b) Economic impact	IDB (Inter-American Development Bank)	Economics of natural disaster					(Oh, et al. 2013)
	National Academy Press	The Impace of Natural Disaster					
	The World Bank	Economics of natural disaster					

	FEMA (Fedral Emergency Management Agency)	Economic Application of Natural disaster					
		Economics of natural disaster					
		Developing the Mitigation Plan: Identifying the Mitigation actions and implementation strategies	✓			Chatham County Pre Disaster Mitigation plans	
	SHIELDUS data set (Spatial Hazard Events and Losses for the United Stated	Data Reports and Mapping of economic loss of natural disaster			✓	City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
c) Social impact	*The world bank*	Popualation at risk of Disaster					(Oh, et al. 2013)
	US AID	Guide to education in natural disaster					
	FEMA (Fedral Emergency Management Agency)	Hazard Vulnarability and risk Analysis	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
	Inidviadual papers/ Reports						
	i. Social Science quaterly	Social Vulnarability to environmental hazard by Susan L. cutter, et.al.					
	ii. American economic review	Poverty aand Vulnerability					
	World health statistics quaterly	Natural and man made disater: the vulnarability of women-headed household and children without family					
	CDC (Center for Disease Controle)	A Social Vulnarabilty Index for Disaster Management					

d) Critical Infrastructure	*ASCE (American Society of Civil Engineering)*	2013 Report for American Infrastructure					(Jha, Miner and Zuzana 2013); (Oh, et al. 2013)
		Guiding Principles for the Nation's Critical Infrastructure					
	United Nations ESCAP	Building Resilience to Natural Disaters ad Major Econimic Crises					
	NIPP (National Infrastrastructure Protection Plan) 2013	Partnering for critical infrastructure security and resilience					
	Department of Homland security	Protected Critical Infrastructure Information (PCII) Program					
		Regional Resiliency Assessment Program					
		Office of Infrastructur Protection Strategic Plan:2012-2016					
		National Infrastructure protection plan					
		Infrastructure Survey Tool					
	United States Government Accountability Office	GPS Disruptions: Effrts to assess risk to critical infrastructure and coordinate agency action should be enhanced					
	FEMA (Fedral Emergency Management Agency)	Critcal Inrastructure resourse center					
		Critical Infrastructure and Key Resources Support Annex					
		FEMA online courses: protecting Critical Infrastructure					
		Critcal Infrastrcture protection and Resilience Toolkit					

		Asset Value, Threat/Hazard, Vulnarability and Risk Assessment	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
		Risk Management Series	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
		Building and Infrastructure Protection Series					
		Risk Management Series: Design Guide for Improving Critical Facility Safety from Flooding and High Winds, FEMA 543	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
	US Energy Informaion Administration	Flood Vulnarability Assessment					
	U.S Department of Commerece	National Institute of Standerds and Technology (NIST)- Developing Guidelines and Standerds for Disaster Resilience of the Built Environment					
e) Ecosystem management	*International Union of Conservation of Nature*	Ecosystem, Livelyhood and disaster: An integrated approch to disaster management					(Jha, Miner and Zuzana 2013); (Philipsborn 2005)
	UNISDR (Uinted nations international strategy of disaster reduction	opportunities in environmental management for disaster risk reduction: Recent progress					
	IUCN (International Union for conservation of nature)	Environmental Guidance Note for Disaster Risk Reduction					
	EPA (United States Environmental Protection Ageancy)	Flood plain Laws and Regulations					
	FEMA (Fedral Emergency Managent Agency)	Executive Order 11988: Floodplain Management	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	

	IPCC (intergovernmental pannel for climate change)	Climate change 2013: The physical science basis	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
f) Land-use planning	*FEMA (Fedral Emergency Managent Agency)*	Building Community Resilience by Integrating Hazard Mitigation: Integrating Hazard Mitigation Into the Local Comprehensive Plan					(Jha, Miner and Zuzana 2013); (Philipsborn 2005)
		Policeis for guiding for Post-Disaster Recover and Reconstruction	✓			Chatham County Disater Recover plan (DRAFT)	
		Landuse plannign for Hazard Mitigation					
		FEMA local mitigation planning Handbook for commmunity	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
		Local mitigation planning handbook					
	APA (American planning Association)	Hazard Mitigation: Integrating best practice into planning					
g) Disaster magement Framework	*FEMA (Fedral Emergency Management Agency)*	National response framework	✓			Chatham County Disater Recover plan (DRAFT)	(Jha, Miner and Zuzana 2013)
h) Insurance and Funding	*FEMA (Fedral Emergency Management Agency)*	Recovery and Rebuild Program					(Jha, Miner and Zuzana 2013)
		The national Flood insurance program	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
	American Red Cross	Recovering Financially					
	The World Bank	Disaster risk managenent					
2) Community Preparedness Policies							
Awareness and Supplie management	*American Red Cross*	Redcross Emercency Preparedness Checklist		✓			

	FEMA (Fedral Emergency Management Agency)	America's PrepareAthon: National Prepareness program		✓			
		Basic Preparedness Kit					
	CDC (Center for Disease Controle)	Emergency prepardness and response		✓			
What to do?	*FEMA (Fedral Emergency Management Agency)*	Are You Ready? An in-depth Guide to Citizen Preparedness					
	American Red Cross	Disaster preparedness for Seniors by seniors	✓			Chatham Disaster Recovery Plan	
		Disaster and Saftey Library					
	CDC (Center for disease controle)	Emergrncy Preparedness and Response					
3) Disaster Response							
a) Warning	*NASA (National Aeronautics and Space Administration)*	NASA GPS System for Hazard warning					(Jha, Miner and Zuzana 2013)
	UNISDR (United Nations. International Strategy for Disaster Reduction)	Developing Early Warning System: A Checklist					
		Guiding Principles for Effective Early Warning					
	USGS (United State Geological Survey)	Early Warning and Environmental Monitoring Program (EWEM)	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	
	ArcGIS (Esri's Geographic Information System)	Early warning System					
b) Response team	*International Rescue Committes*	Emergency response relief team					(Philipsborn 2005)
	ASPCA (American Society for the Prevention of Cruelty to Animals)	Natural Disaster Rescue program					

	FEMA (Fedral Emergency management Agency)	Community Emergency Response Team					
		National Incident Management Syatem	✓			Chatham Disaster Recovery Plan	
c) Shelter facility	CDC (Center for disease controle)	Infection Control Guidance for Community Evacuation Centers Following Disasters					(Jha, Miner and Zuzana 2013); (Philipsborn 2005)
	FEMA (Fedral Emergency management Agency)	Risk Management Series: Design Guidance for Shelters and Safe Rooms FEMA 453	✓			Chatham Disaster Recovery Plan	
	Pennsylvania, Emergency Management Agency	Disaster Preparedness Planning Guide For Facilities					
	Department of Homeland Security	Disaster Assistance Improvement Program (DAIP)					
d) Health Facilities	*CDC (Center for disease controle)*	Infection Control Guidance for Community Evacuation Centers Following Disasters					(Cutter, Boruff and Shirley, Social vulnarability to environmental hazard 2003); (PERI 2005)
	American Red Cross	Disaster Services					
	FEMA (Fedral Emergency management Agency)	Emergency Support Function #6 – Mass Care, Emergency Assistance, Temporary Housing, and Human Services Annex	✓			Chatham Disaster Recovery Plan	
	WHO (World health Organization)	Hospital Emergency Response Checklist					
	United States public health service	Disaster Inspections of Medical Facilities					

	National Association of Community Health Center	Assistance Before, During, and After Emergencies and Disasters					
	International Fedration of Red Cross	Emergency Health Servicce					
	Joint Commission	Standing Together: An Emergency Planning Guide for America's Communities					
e) Child Care facilities	NACCRRA (National Association of Child Care Resource & Referral Agencies)	Protecting Children in Child Care During Emergencies					(Jha, Miner and Zuzana 2013); (PERI 2005); (Cutter, Boruff and Shirley, Social vulnarability to environmental hazard 2003)
	National Institute of Health	Maternal health considerations during disaster relief					
	Office of Child Care	State Regulatory Requirements for Emergency Preparedness Planning					
	NH Child Development Bureau, Child Care Licensing Unit, Child Care Resource and Referral Network, NH Emergency Management of Department of Safety and Easter Seals NH.	Family Child Care Emergency Preparedness Guide					
	CDC (Center for Disease Controle)	Guidelines for the Management of Acute Diarrhea After a Disaster					
	FEMA (Fedral Emergency management Agency)	Post-Disaster Reunification of Children: A Nationwide Approach			✓	Department of Family & Children Services (DFCS) 2009 Business Continuity/Emergency Preparedness Plan	

	Department of Homland security	Supplemental Resource: Children in Disaster Guidance					
f) Communication Facilities	*Fedral Communication Commission*	TPS (Telecommunication Service Priority) Program					(Jha, Miner and Zuzana 2013)
		GETS (Government Emergency Telecommunication Service)					
		WPS (Wireless Priority Service) Program	✓			Chatham County Emergency Operation Plan	
g) Clean up	*SBA (US Small Business Administration)*	Guide to cleaning up saftely after a disaster					(Jha, Miner and Zuzana 2013); (PERI 2005)
		Cleaning and Sanitizing with Bleach After an Emergency					
		Cleaning Flood Contaminated HVAC Systems: A Guide for Building Owners and Managers					
		Dealing with Debris and Damaged Buildings					
		Disposing of Debris and Removing Hazardous Waste					
		After a Hurricane or Flood: Cleanup of Flood Water					
		Flood Cleanup Fact Sheet					
		Mold Cleanup in Schools and Commercial Buildings					
	CDC (Center for Disease Controle)	Flood Water After a Disaster or Emergency					
		Fact Sheet: Clean Up Safely After a Disaster					
	US EPA (US Environment protction Agency)	Planning for Disaster Debris					
		Planning for Polychlorinated Biphenyl (PCB)-Containing Disaster Debris					

	FEMA (Fedral Emergency management Agency)	Debris Management Guide	✓			Chatham Disaster Recovery Plan	
4) Recovery and Reconstruction							
Short-Term and Long-Term Recovery Plans	*FEMA (Fedral Emergency management Agency)*	National Disaster Recovery Framework: Community Planning and Capacity Building Recovery Support Function	✓			Chatham Disaster Recovery Plan	(Jha, Miner and Zuzana 2013); (PERI 2005)
		National Disaster Recovery Framework Strengthening Disaster Recovery for the Nation	✓			Chatham Disaster Recovery Plan	
		Policies for Guiding Planning for PostDisaster Recovery and Reconstruction					
		Disaster Assistance: A Guide to Recovery Programs FEMA 229(4)					
		Continuity Plan template for Federal Departments and Agencies					
		Planning for Post-Disaster Recovery and Reconstruction	✓			Chatham Disaster Recovery Plan	
		Long Term Community Recovery Planning Process: A Self-Help Guide					
	American Red Cross	Disaster Recovery: A Guide to Financial Issues (A5076).	✓			Chatham Disaster Recovery Plan	
	EPA (Environmental Protection Agency)	American Recovery and Reinvestment Act (ARRA) of 2009					
		Beach Grants					
		Catalog of Federal Funding					
		Clean Water State Revolving Fund					
		Drinking Water State Revolving Fund (DWSRF)					

		Federal Funding for Water/Wastewater Utilities in National Disasters (Fed FUNDS)					
		Safe Drinking Water Act					
		Watershed Funding					
	Public Entity Risk Institute	HOLISTIC DISASTER RECOVERY Ideas for Building Local Sustainability After a Natural Disaster					
	OECD (United states Organisation of Economic Co-operation and Development)	Building resilient regions: Lessons for policy making in post-disaster regions					
	DERA (Disaster preparedness and Emergency Response Association)	Colorado Flood recovery plan					
	American Red Cross	Disaster Recovery: A Guide to Financial Issues (A5076).					
		PICKING UP THE PIECES AFTER A DISASTER Important Steps for Your Safe and Speedy Recovery					
	IEG (Independent Evaluation Group) World Bank	Natural Disaster Response Lessons from Evaluations of the World Bank and Others					
Total no of issues under in each catagories			**16**	**1**	**1**		

Source: Produces by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA 2015

According to the resiliency matrix for organization structure for the city of Savannah, shows that out of 18 identified issue, city has addressed 16 of them properly. City has to improve the document about the child care facility during and after the disaster event. But one section of document that Savannah really need to focus on is:

a) The education and public outreach program for communities.

Again, city of Jacksonville have a very well defined education and public outreach program available as one of their planning document, which can be referred Savannah to create their own or city of Savannah can use one of the available documents from different government agencies to fill in the gap. This will help in preparing community about the natural event and precaution they need to take.

Ecological resiliency for the city of Savannah

City of Savannah is situated at low coastal plain with a protective surrounding of tidal marshes. The elevation of the city is 48' in the downtown Savannah. The city has boarder of Savannah River from north and Ogeechee River from south. City of Savannah is a pool of numerous Cultural Historic and natural resource. Also the city have barrier islands like Tybee, Ossabaw, Cabbage and Wassaw islands. The coast line of city consist of wetlands ranging from freshwater, non-tidal and tidal wetlands to estuaries wetland or salt marshes. These marsh land and barrier island are not only important for protecting the city from flooding and sea level rise, but also support the city by providing fresh drinking water and food supply. These marshes are home for several natural aquatic habitat like, fish, shell fish, waterfowl and other wildlife species (Savannah, City of Savannah DRAFT floodplain mitigation plans 2015). Since the city is supporting and supporting on a rich ecological system, it is important to protect and maintain the system for smooth functioning of the system. Thus the resiliency matrix is applied to the planning documents of the city of savannah to ensure the protection of cities ecosystem. The composition of the resiliency matrix for the ecosystem management is similar to the demographic and physical infrastructure resiliency. It contains a list of information available for resiliency of ecological management for the city of Savannah.

Table 7-5 Resiliency matrix of ecosystem management for Savannah GA

Issues defining resilience of ecosystem	Measurment value	Planning documents of Savannah			Source of information	Possible sources for data availability	Documents referred
		Addressed	Not Addressed	Needs an update			
1) Climatic Change							
a) Extent of Ecosystem	Area	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	Remote Sensing data	(EPA 2002)
b) Type of Ecosystem	landusedata	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	Remote Sensing data	(EPA 2002)
c) Land-Use pattern/ Structure	Fragmentation pattern	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015); Chatham County- Savannah, Tricentennial Plan/ Chatham County-Savannah Comprehensive Plan: Community Assessment report 2006	Remote Sensing data	(EPA 2002)
d) Composition of Ecosystem	Ex: wetland, Marsh, Coral reef	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015); Chatham County- Savannah, Tricentennial Plan/ Chatham County-Savannah Comprehensive Plan: Community Assessment report 2006	Remote Sensing data	(EPA 2002)
e) % Vegitated land and description	Percentage	✓			Tricentennial Plan/ Chatham County-Savannah Comprehensive Plan: Community Assessment report 2006		
f) % agriculture land	Percentage	✓			Tricentennial Plan/ Chatham County-Savannah Comprehensive Plan: Community Assessment report 2006		(Bank 2015)
g) % rural development	Percentage	✓			Tricentennial Plan/ Chatham County-Savannah Comprehensive Plan: Community Assessment report 2006		(Bank 2015)

h) % urban development	Percentage			✓	Chatham County Hazard Mitigation Plan - Draft for NCEM Review, July 2004		
i) Change in ecosystem composition	Percentage			✓	Chatham County GIS data base		(EPA 2002)
j) Composition of Air	data			✓	Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch; Ambient Monitoring Program; Air Quality Index Savannah	Departmet of natural resource	(Bank 2015)
k) CO2 Emission	metric tons per capita			✓	Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch; Ambient Monitoring Program; Air Quality Index Savannah	Departmet of natural resource	(Bank 2015)
l) Nitrious oxide emission	metric tons per capita			✓	Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch; Ambient Monitoring Program; Air Quality Index Savannah	Departmet of natural resource	(Bank 2015)
m) Methane Emission	metric tons per capita			✓	Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch; Ambient Monitoring Program; Air Quality Index Savannah	Departmet of natural resource	(Bank 2015)
n) Green House gas emission (HFC, PFC and SF6)	metric tons per capita			✓	Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch; Ambient Monitoring Program; Air Quality Index Savannah	Departmet of natural resource	(Bank 2015)

o) Annual fresh air withdrawal	metric tons per capita			✓	Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch; Ambient Monitoring Program; Air Quality Index Savannah	Departmet of natural resource	(Bank 2015)
p) Electric power consumption	kWh per capita		✓			Energy information administration	(Bank 2015)
q) Energy power production	kWh per capita		✓				(EPA 2002)
r) oil consumption	kWh per capita		✓				(Bank 2015)
s) Ground water flow	% impervious surface	✓			Chatham County-Savannah, Tricentennial Plan/ Chatham County-Savannah Comprehensive Plan: Community Assessment report 2006	land use data	(EPA 2002)
t) water quality		✓			Chatham County-Savannah, Tricentennial Plan/ Chatham County-Savannah Comprehensive Plan: Community Assessment report 2006		
u) Population growth	annual %	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	Census data	(Bank 2015)
v) Total population	number	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	Census data	(Bank 2015)
w) Rural population	% total population	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	Census data	(Bank 2015)
x) Urban population		✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	Census data	(Bank 2015)
y) Urban growth rate	% increase in grey surface			✓	City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	Smart Grouth America, Measuring Sprawl 2014	(Bank 2015)

2) Effects of climate change							
a) Geomorphological studies	List of major changes	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	NOAA	(EPA 2002)
b) Change in landscape	% increase or decrease on green cover	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)		(Bank 2015)
c) Change in vegetation type	List of major vegetation before and after			✓	City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)		(EPA 2002)
d) Effects in the agricltural production	% chage in agricultural production			✓	Chatham County, North Carolina Agriculture Land Use Plan (http://www.chathamnc.org/Modules/ShowDocument.aspx?documentid=14459)		(Bank 2015)
e) Change in the natural buffers	% increase or decrease in the size of natural buffer	✓			Chatham County-Savannah, Tricentennial Plan/ Chatham County-Savannah Comprehensive Plan: Community Assessment report 2006		(EPA 2002)
f) change in precipitation	Annual precipitation in mm			✓	Georgia: USGA South Atlantic Water Science Center		(EPA 2002)
g) Increase in temperature	Rise in temperature			✓	Georgia: USGA South Atlantic Water Science Center		(Bank 2015)
h) Annual sea level rise	in mm			✓	Georgia: USGA South Atlantic Water Science Center		(EPA 2002)
i) change in ground water level	in mm			✓	Georgia: USGA South Atlantic Water Science Center		(EPA 2002)
j) Change in water quality	components and their percentages in the water			✓	Georgia: USGA South Atlantic Water Science Center		(Bank 2015)

k) Different natural events observed	list of events	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)		
l) Frequency of the natural event	Number	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)		(Bank 2015)
m) Intensity of the natural events	distruction caused by event	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)		(Bank 2015)
n) Zone of impact for the natural events	Area effected by the natural event	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)		(EPA 2002)
o) Change in natural buffers	area and types of natural buffers present currently	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)		(EPA 2002)
3) Policies							
a) Land use plans	Document	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	FEMA	
b) Zoning ordinance	Document	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	FEMA	
c) Construction standerds	Document	✓				FEMA	(Scott Tezak; David K. Low; Adam Reeder 2009)
d) Clean air act	Document			✓	Chatham County-Savannah, Tricentennial Plan/ Chatham County-Savannah Comprehensive Plan: Community Assessment report 2006	EPA	(EPA, Air Pollution and the Clean Air Act 2013)
e) Clean water act	Document			✓	Chatham County-Savannah, Tricentennial Plan/ Chatham County-Savannah Comprehensive Plan: Community Assessment report 2006	EPA	(EPA, Clean Water Act (CWA) Compliance Monitoring 2015)
f) Shoreline protection act	Document	✓			Georgia Coastal and Estuarine land conservation program 2011	EPA	(EPA, Lake Shoreland Protection Resources: Clearinghouse for Information on Lakeshore Protection and Restoration 2014)
g) Ecosystem management program	Document	✓			Georgia Coastal and Estuarine land conservation program 2012	IUCN (International Union of Conservation of Nature)	(IUCN 2014)

h) Green power partnership	Document	✓			A road map for CHATHAM COUNTY for its journey in becoming THE GREENEST COUNTY in the STATE of GEORGIA	EPA	(EPA, Green power Partnership 2015)
i) Heat island reduction initiative	Document		✓			EPA	(EPA, Reducing Urban Heat Islands: Compendium of Strategies 2013)
j) Clean power plan toolbox for state	Document	✓			A road map for CHATHAM COUNTY for its journey in becoming THE GREENEST COUNTY in the STATE of GEORGIA	EPA	(EPA, Clean Power Plan Toolbox for States 2014)
k) Mitigation Ideas: A resource for reducing risk to natural hazards	Document	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	FEMA	(Baxter, et al. 2013)
l) Coastal mapping	Document	✓			City of Savannah DRAFT Floodplain Mitigation Plan (Feb 2015)	FEMA	(FEMA n.d.)
Total no of issues under in each catagories		**30**	**4**	**18**			
Source: Produces by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA							

Table 5 shows the resiliency matrix for the ecosystem management for the city of Savannah. Out of 52 issues identifies for defining resiliency of ecosystem management for a city for reducing the impact of natural event, 30 were addressed properly in the planning documents of the city of Savannah. 18 issues need update in terms of addressing them in the planning document and 4 issues are missing or not addressed at all. These issues are:

a) ***Amount of natural energy/ power produced on site to calculate its effect on the surrounding environment***

b) ***Amount of natural energy consumed by the city.***

c) ***Oil/ gas consumption to calculate the air and water quality in the surrounding system***

d) Proposal or planning documents for reducing the heat island effect of the city due to rapid growth and industrialization.

These missing information needs to be updated in the planning document to reduce the impact of urbanization on the natural ecosystem. The data for calculations can be extracted from Georgia power department and the guidelines to incorporate those data in the planning documents can be adopted from the resources provided in the resiliency matrix sheet.

The next part in measuring the resiliency is socio-economic resiliency which is more of understand the social and economic interactions, thus it was difficult to calculate in the form of a matrix. So this section is discussed at the end together with the city Jacksonville

7.4.2 Application of the Resiliency Matrix on the Planning Documents of Jacksonville, FL

Jacksonville is located in the northeast corner of the State of Florida, approximately 10 miles from the state of Georgia. The total area of the city is 850.27 Square miles (i.e., 544,175 acres) with a population of 842,583 in 2013 which is an increase of 14.3% since 2000 US census data. The urban development in the Jacksonville first started in 1822 when the site was surveyed and formally organized. The development basically started at the St Johns River on the king's road from Georgia to St Augustine. The development further increased with the advent of railroad in the city, increasing the tourist destination in late 1800's. Apart from well-developed road and rail connection, Jacksonville is home for the largest port of the state on the St Johns River, further encouraging the development in the city. Although City of Jacksonville is comparatively west to other coastal cities of the Florida, it has been lucky enough to avoid direct hit from major hurricanes. The only direct hit Jacksonville have experienced was hurricane Dora in 1964 (City of Jacksonville/Duval County 2010). But this doesn't mean that the city doesn't need to be prepared for one. Also because of its location

closer to the center or Georgia Bight, increases its susceptibility to frequent flooding and sea level rise.

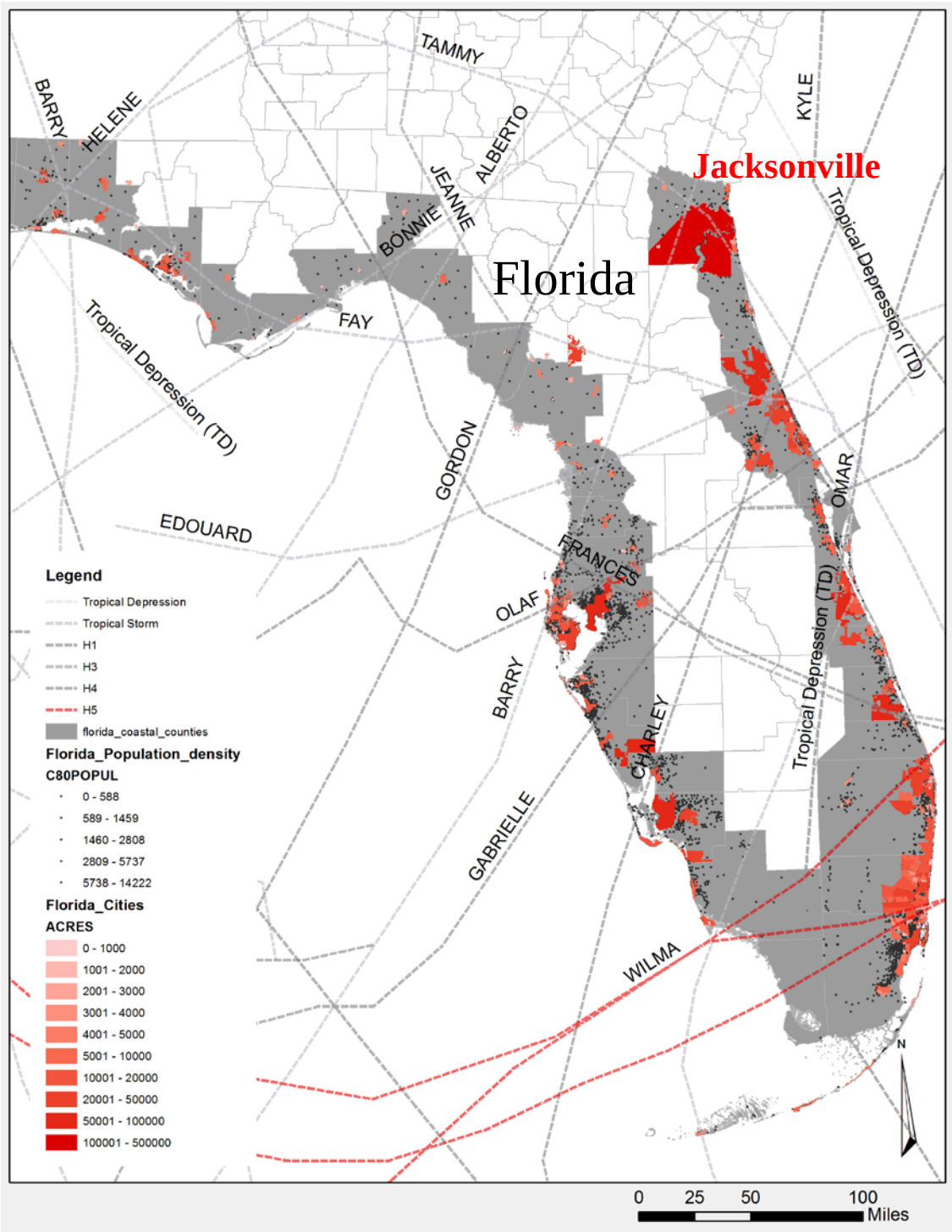


Figure 7-8 Map showing the coastal cities and counties for the state of Florida

Considering this, Florida was the first state to adopt and mandate hazard mitigation planning for the coastal cities, and disaster recovery plan in their comprehensive plan. As a result of this, Jacksonville has a well-defined Emergency management plan in place. It would be interesting to see that, since the city already have a emergency management plan in place, does it address most of the identified issues of the resiliency matrix. This process will help testing the applicability of the matrix. Thus this section will be applying the resiliency matrix to the planning documents of the city of Jacksonville under the same categories (demography, urban infrastructure, ecosystem management and socio-economy) as discussed for Savannah in the previous section.

Demographic resiliency for Jacksonville FL

As Jacksonville was developed in 1822 around the St Johns River to serve the traffic crossing the river. The development in the area further spurred with the advent of railroad in the area, especially crossing the St Johns River. This development brought in the tourist activities and then the development of major commercial and industrial activities along the river, radiating out from the original center of the Jacksonville. Thus the population was basically distributed along the St Johns River. Current city of Jacksonville is the biggest city in the state by area and population. Since the city basically started with trade and tourism, according to the data collected by visit Jacksonville, there are approximately 10,000 to 15,000 visitors per day in the city. Along with this floating population, Jacksonville has a huge no. of transient population according to the US department of business. Also the economic source of city (i.e. trade and tourism), brings in a diverse group of population migrating from Mexico, Canada and other parts of world. On top of having such a diverse group population, according to the Jacksonville community service department, Jacksonville have a huge population of elderlies

and people with hearing impairment (City of Jacksonville/Duval County 2010). Since the city is supporting such a diverse and vulnerable group of population, it is important to see whether the city's emergency management plan have addressed the issues for its demographic resiliency or not.

The process of testing the demographic resiliency is the same as that was adopted for the city of Savannah, GA. The planning documents of the city of Jacksonville will be reviewed on the basis of the matrix created for the demographic resiliency in the previous chapters. 1 point will be allotted on successfully addressing an issue defined in the matrix and towards the end of it a resiliency score will be created for the city. The table in the next section shows the application of the demographic resiliency matrix on the planning documents of City of Jacksonville and includes the information city emergency management documents have:

Table 7-6 Matrix of demographic resiliency for city of Jacksonville FL

Issues of Demographic Resilience	Measurment value	Planning document of Jacksonville			Source of information	Possible sources for data availability
		Addresssed	Not Addressed	Needs an update		
1) Geographical location						
a) Location	Proximity to a natural disaster	✓			Duval County 2010 Local Mitigation Stratagey	USGA Geological data
b) Type of natural disaster	Intensity of the disaster type	✓			Duval County 2010 Local Mitigation Stratagey	National Weather Services- For hurricane path National elevation data- For Sea level rise
c) Estimated boundar or distruction by natural disaster	Path of hurricane or Area under sea level rise	✓			Duval County 2010 Local Mitigation Stratagey	National Weather Service/ National Hurricane Center

d) % Area of city under the estimated boundary of natural disaster (ex: area under 3ft sea level rise)	Area ratio	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	GIS mapping (overlapping the layers of total area of city and area under estimated boundary of natural disaster)
2) Census data						
a) Total population of city	Total no. of peoples	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	United state census bureau
b) Estimated population growth	Percentage of population growth in the city in next 10 years	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	US census bureau- Population projection
c) Population types:						
i) Population under age group of 18 years	Percentage of population	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	US census bureau
ii) Population under age group of 18-64 years	Percentage of population	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	US census bureau
iii) Population age group of 65 years and above	Percentage of population	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	US census bureau
d) Percentage of population under the estimated hazard zone	Percentage of population	✓			Duval County 2010 Local Mitigation Stratagey	
e) Percentage of critical population under the estimated hazarad zone	Percentage of population	✓			Duval County 2010 Local Mitigation Stratagey	
i) Percentage of elderly population						
ii) Population under age group of 22-60 years						
iii) Population in age group of 21 years and below						
f) Percentage of population suffering from an chronic disease	Percentage of population	✓			Duval County 2010 Local Mitigation Stratagey	Center for Disease Controle, State Profile
g) Location of medical centers	Locational maps and accessibility data	✓			Florida Geographic data library (ftp://ftp1.fgdl.org/pub/state/)	State clearing house, GIS Data

h) Critical facilities provided in the hospitals in case of emergency	list of facilities	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	Individual hospital website/ Survey
I) Backup plans for the hospital and other medical facilities		✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	
j) Race and Ethinicity	Percentage of population types	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	US Census data
k) Percentage of population of womens	Percentage	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	US Census data
m) Education levels	Percentage of populaton	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	US Census data
i) percentage of population with secondary education		✓				
ii) percentage of population with high-secondary education		✓				
ii) percentage of population with college education		✓				
n) Education and outreach programs for the possibel disaster events and saftey measures		✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	
o) Location of Emergency shelters	Maps showing the possible location of shelters	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	
p) Approximate capacity of the emergency shelters	Percentage of population its accomodating	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	State mass care shelter program, and Center for disease controle
q) Child care centers	List of all the child care centers	✓			Community Services Block Grant (CDBG), Florida department of children and family	State mass care shelter program, and Center for disease controle

r) Pet rescue plans	list of agencies that would be involved in pet rescue plans	✓			Florida Pet Friendly Emergency Shelters	Federal Pets Evacuation and Transportation Standards (PETS)
s) Emergency management plans for food supply, fresh water and electricity	List of agencies that would be involved	✓			Jacksonville Central Operations Department/Procurement Division	Center for disease controle, Fedral Emergency Management Plans
t) Evacuation plans	List of agencies involved and detail discription for the plan	✓			Jacksonville/ Duval County, Florida Comprehensive Emergency	FEMA Evacuation Liaison team, Fedral highway administration, State Department of Transportation
u) Types of Business	List of all the different types of bussiness and their economic gains	✓			Jacksonville/ Duval County, Florida Comprehensive	State department of economics
v) Potential economic loss after disaster	percentage of bussiness under the estimated hazard zone	✓			Consolidated City of Jacksonville/ Duval County, Florida	State GIS Clearing house, Tax assessors office
w) Tourist evacuation plan	Document	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	FEMA- Developing and Maintaing Emergency operation plans
3) Hazard Mitigation plans for people						
a) Understanding the type of hazard	Document	✓			Duval County 2010 Local Mitigation Stratagey	
i) Previous disaster caused by similar disaster		✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	
ii) Awareness programs		✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	
b) Types of Infrastructure under risk of hazard	Percentage of each type of infrastructure	✓			Duval County 2010 Local Mitigation Stratagey	County GIS Data
i) Industrial						
ii) Corporate						
iii) Residiential						
iv) Highways						
v) Electrical grids						
vi) Ports						
c) Property valuation report to understand the risk associated with it at different geogrphical locations.	Document	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	Tax assessors office

d) Building Construction standerds	List of standerds	✓			Florida building cide 2014	FEMA- Home Builder's Guide for Coastal Construction
e) Insurance policies for building in the estimated range of hazard	Special rates for flood insurance of properties under the flood zone or ther natural hazard	✓			National Flood insurance program	Home owener's Guide, Flood insurance rate map for states
f) Critical hotspot mapping for econimic center	Percentage of the critical infrastructure for economical center under the estimated hazard zone	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	GIS data for business
g) Awareness programs for :		✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	
i) The disaster relief programs						
ii) Proparty insurance programs						
iii) Health insurance program						
iv) Disaster recovery programs						
h) Reocation plan for critical infrastructure and econic center, in the hazard zone	Document type with phase plans for relocation	✓			2030 Comprehensive plan, future landuse element	
4) Management of critical population						
a) Percentage of Elderly population in city	Percentage of population	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	US Census data
b) Percentage of Elderly population with a chronic disease	Percentage of population		✓			Center for Disease Controle, State profile
c) Percentage of population under poverty line	Percentage of population	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	US Census data
d) Medical facilities and supply centers for population with chronic disease	Document	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	Center for Disease Controle
e) Special evacuation facility for critical population	Document	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	Department of health and human services, FEMA

f) Food suply and temporary accomodation facility, especially for peoples under poverty line	Document	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	National disaster housing stratagies FEMA, Emergency Support function, FEMA and Department of homeland security
g) Earlier evacuation facilities for critical population	Document	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	Florida Department of Health, Hospital evacuation tool kit
h) Facilities for low rate insurance policy for population under poverty line	Document	✓			Florida Deportment of Elder Affairs	
i) For property						
ii) For health						
i) Special educationa and outreach program for population under poverty line and eldarly population to avoid property fraud, and exploitation after disater	Document	✓			Florida Deportment of Elder Affairs	Community eduction and outreach FEMA
Total no of issues under in each catagories		**53**	**1**	**0**		
Source: Produces by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA 2015						

Table 6 shows the matrix of the Demographic resiliency for City of Jacksonville FL. Compare to Savannah we can see a clear difference in the documentation type for mitigating the effects of disaster. Out of 54 issues identified for the demographic resiliency, city was successful in addressing 53 of them. Only one issues that needs to be incorporated in the planning documents for increasing the demographic resiliency are:

a) Considerations for elderly population with chronic disease.

Next section will be measuring the resiliency of urban infrastructure of the planning documents for the city of Jacksonville, FL.

Resiliency of Urban infrastructure for Jacksonville FL

As discussed in earlier sections, the assessment of urban infrastructure will be done in two forms, Physical and organizational infrastructure. With the increase in tourism and trade routes, there was a sudden boom in the population around St Johns River in the city of Jacksonville. This led to the development of residential, commercial, and industrial properties. Because of its convenient location, mild climate and plenty of open space for development, Jacksonville is one of the populate location for corporate expansion and relocation. The city has a status of intermodal transportation hub, making it as a leading distribution center with transportation network embracing port, air cargo, and rail and trucing routs. Millions of tons of raw material and manufacturing goods move through city providing sufficient reasons for expansion of huge cargo storage facilities and warehouses. Also Jacksonville with its business friendly government, was named as third least expensive city to launch corporate headquarters by US chamber of commerce. The millage rate on real property is lowest in the state of Florida. Thus all these factors have a combine effect on growth pattern of city, making it the biggest city of state, not only in terms of population and area, but also in terms of development. The city has the largest port of the state and is rated as one of the "hottest cities in America" for business expansion and relocation in an annual pole featured in Expansion management magazine (City of Jacksonville 2013). In order to avoid any major economic loss caused to such infrastructure form any natural event (in this case, flooding, sea level rise and tropical storms) it is important to have a well defines hazard mitigation or emergency management plan laid in place. Although state of Florida is one of the 11 states adopting multi-hazard mitigation plan status in United States and also one of the

few states mandating its implementation in the coastal cities, it would be interesting to see whether it has addressed the identified issues in the matrices of urban infrastructure.

The following section will show the application of resiliency matrix of physical infrastructure in the planning documents of city of Jacksonville. If the city has successfully addressed the issues identified in this section, it can be used to fill the missing gaps of the planning documents of Savannah GA, by providing the sources of particular documents to use for reference.

Table 7-7 Resiliency matrix of physical infrastructure for Jacksonville FL

Issues of Resilience in physical infrastructure	Measurment value	Planning document of Jacksonville			Source of information	Possible sources for data availability	Documents referred
		Addresssed	Not Addressed	Needs an update			
1) Nature of natural event							
a) Type of natural disaster	List of disaster events place is suceptable to (study from history of the place)	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	NOAA national weather service, Office of climate, water and weather services	(Oh, et al. 2013), (Cutter, Mitchell and Scott 2000),
b) Frequency of natural disaster	(No. of events x 100) ÷ (No. of years)	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	FEMA, national reaserch council, local news sources	Cutter, Mitchell and Scott 2000
c) Zone of impact of natural disaster	mapping the area of impact for natural disaster	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	NOAA GIA data for hurricane, FEMA floof map	Cutter, Susan L., Bryan J. Boruff, and Lynn W. Shirley. 2003, Cutter, Mitchell and Scott 2000
d) Forms of impact caused by the natural event	Distruction caused throurh water, gas, or solid	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	Study of different types of natural disaster	Lindell, Michael K., and Carla S. Parter. 2003

2) Identification of Critical Infrastructure							
a) identification of frequently used infrastructure	Interviews from local public	✓			Duval County 2010 Local Mitigation Stratagey	Interviews and local comminity data	Oh, et al. 2013
b) Comparing it with the list of critical infrastructure identified by CRS, FEMA, ASCE	list of data already identified before	✓			Duval County 2010 Local Mitigation Stratagey	*2013 report card for America's Infrastructure.* American Society of Civil Engineering; Critical infrastructure and key resources support annex. Fedral Emergency Managment Agency; Critical Infrastructure and Key Assets: Defination and Identification. Washington DC: CRS report for congress.	Moteff, John, and Paul Parfomak. 2004; Oh, Eun Ho, Abhijeet Deshmukh, Makarand Hastak, and M.ASCE. 2013; ASCE. 2013.; FEMA. 2008.
c) Normalizing the identified infrasyructure as per their social and economic contribution	Interviews of the people as per the usage of the infrastructure	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	Inputs from local government and citizens	Oh, et al. 2013
d) Calculating the impace of 3 major infrastructure:							
i) Electricity	Calculating the social and economic impact of power outage	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan		Oh, et al. 2013

ii) water	Calculating activities dependent on water supply	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan		Oh, et al. 2013
iii) road	Identifying the important road network and its supporting population	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	State Department of transportation	Oh, et al. 2013
e) Mapping of the identified critical infrastructure in the hazard impact zone	Map showing the location of infrastructure	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	Local researchers	Lindell, Michael K., and Carla S. Parter. 2003
f) Evaluating the physiscal condition of the critical ifrastructures	Report			✓	City of Jacksonville, FL, Building inspection division	American society of civil engineers, state chapters	ASCE. 2013. *2013 report card for America's Infrastructure*
3) Regulations for maintaining the critical infrastructures							
a) Funds and policies for improving the conditions of critical infrastructures	Report	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan	Water supply improvement program (WSIP), Pre-Disaster Mitigation Funds (PDM) From FEMA, Beach Act by Enviormental protection Agency, Clear water state revolving funds, etc.	ASCE. 2013. *2013 report card for America's Infrastructure*

b) Construction and improvemnet standerds (for existing structures) for critical infrastructures	Report	✓			Florida building coad	FEMA building construction coads	FEMA. 2005.Summary of Coastal Construction Requirnment and Recommendation
c) Insurance policies for the critical infrastructure	Report	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan		
d) Phaseing of the relocation policies for the critical infrastructure.	Report			✓	Post-Disaster Redevelopment Planning Funding Resources Companion Handbook		
e) Identification of the critical population group associated with the critical infrastructure	Report	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan		
f) Special health care facilities for the critical population during the time of natural disaaster	Report	✓			Consolidated City of Jacksonville/ Duval County, Florida Comprehensive Emergency Management Plan		
g) Programs for alternative way of communication during the disaster conditions	Program and product development	✓			Duval County 2010 Local Mitigation Stratagey	Cell on wheels program	(Jha, Miner and Zuzana 2013)
Total no of issues under in each catagories		**17**	**0**	**2**			
Source: Produces by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA 2015							

According to Table 7, showing the resilience matrix for the physical infrastructure for Jacksonville FL, out of 19 issues identified, the planning document of Florida has successfully addressed 17 and needs to update 2 of them in term of the documentation of information. Thus

the planning document of the city of Jacksonville seems to be 95% (approx.) physically resilient for the disturbance caused by any natural event.

In the next section the availability of different planning document will be tested for different phases of hazard management i.e. mitigation, preparedness, response and recovery for the city.

Table 7-8 Resiliency matrix of organizational infrastructure for Jacksonville FL

Phases of organizational structure	Agencies involved	Guides provided by agencies and researchers	Planning document for Jacksonville			Source of information	Documents referred
			Implemented	Not Implemented	Needs an update		
1) Mitaigation plan							
a) Risk Assessment	*FEMA (Fedral emergency management Agency)*	National Hurricane Center					(Jha, Miner and Zuzana 2013); (Oh, et al. 2013)
		Historical Hurricane Tracks					
		FEMA flood hazard mapping	✓			Duval County 2010 local mitigation strategy	
		National Geophysical Data Center					
		National water and climate center					
		National climatic data center					
		National hazards center					
		Flood map service center	✓			Duval County 2010 local mitigation strategy	
		Floods and Flash Floods Information					
		FEMA national flood hazard layer	✓			Duval County 2010 local mitigation strategy	
		FEMA, HAZUS-MH Software	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	

	USGS (United States Geological Survey)	National Flood frequency Program					
		USGS Natural Hazard Gateway					
	NASA (National Aeronautics and Space Administration)	Global Flood hazard frecquency and distribution					
	NOAA (National Oceanic and atmospheric administration)	NOAA Coastal Service Center	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
		Weather Saftey and Preparedness Brochures					
	Arc GIS (Geographic information system)	Flood frequency class mapping	✓				
b) Economic impact	IDB (Inter-American Development Bank)	Economics of natural disaster					(Oh, et al. 2013)
	National Academy Press	The Impace of Natural Disaster					
	The World Bank	Economics of natural disaster					
	FEMA (Fedral Emergency Management Agency)	Economic Application of Natural disaster	✓			State of Florida 2012 Comprehensive emergency management plan	
		Economics of natural disaster					
		Developing the Mitigation Plan: Identifying the Mitigation actions and implementation strategies	✓			State of Florida 2012 Comprehensive emergency management plan	

	SHIELDUS data set (Spatial Hazard Events and Losses for the United Stated	Data Reports and Mapping of economic loss of natural disaster					
	US Census Bureau	American Community Survey	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
c) Social impact	*The world bank*	Popualation at risk of Disaster					(Oh, et al. 2013)
	US AID	Guide to education in natural disaster					
	FEMA (Fedral Emergency Management Agency)	Hazard Vulnarability and risk Analysis	✓			State of Florida 2012 Comprehensive emergency management plan	
		NFIP (National Flood Insirance Program	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
	Inidviadual papers/ Reports						
	i. Social Science quaterly	Social Vulnarability to environmental hazard by Susan L. cutter, et.al.					
	ii. American economic review	Poverty aand Vulnerability					
	World health statistics quaterly	Natural and man made disater: the vulnarability of women-headed household and children without family					
	CDC (Center for Disease Controle)	A Social Vulnarabilty Index for Disaster Management					

d) Critical Infrastructure	*ASCE (American Society of Civil Engineering)*	2013 Report for American Infrastructure					(Jha, Miner and Zuzana 2013); (Oh, et al. 2013)
		Guiding Principles for the Nation's Critical Infrastructure					
	United Nations ESCAP	Building Resilience to Natural Disaters ad Major Econimic Crises					
	NIPP (National Infrastrastructure Protection Plan) 2013	Partnering for critical infrastructure security and resilience					
	Department of Homland security	Protected Critical Infrastructure Information (PCII) Program	✓			Florida's Critical Infrastructure Protection	
		Regional Resiliency Assessment Program					
		Office of Infrastructur Protection Strategic Plan:2012-2016	✓			Florida's Critical Infrastructure Protection	
		National Infrastructure protection plan	✓			Florida's Critical Infrastructure Protection	
		Infrastructure Survey Tool					
	United States Government Accountability Office	GPS Disruptions: Effrts to assess risk to critical infrastructure and coordinate agency action should be enhanced					
	FEMA (Fedral Emergency Management Agency)	Critcal Inrastructure resourse center					
		Critical Infrastructure and Key Resources Support Annex					

		FEMA online courses: protecting Critical Infrastructure					
		Critcal Infrastrcture protection and Resilience Toolkit					
		Asset Value, Threat/Hazard, Vulnarability and Risk Assessment					
		Risk Management Series					
		Building and Infrastructure Protection Series					
		Risk Management Series: Design Guide for Improving Critical Facility Safety from Flooding and High Winds, FEMA 543					
	US Energy Informaion Administration	Flood Vulnarability Assessment					
	U.S Department of Commerece	National Institute of Standerds and Technology (NIST)- Developing Guidelines and Standerds for Disaster Resilience of the Built Environment					
e) Ecosystem management	*International Union of Conservation of Nature*	Ecosystem, Livelyhood and disaster: An integrated approch to disaster management					(Jha, Miner and Zuzana 2013); (Philipsborn 2005)
	UNISDR (Uinted nations international strategy of disaster reduction	opportunities in environmental management for disaster risk reduction: Recent progress					

	IUCN (International Union for conservation of nature)	Environmental Guidance Note for Disaster Risk Reduction	✓			Duval County 2010 local mitigation strategy	
	EPA (United States Environmental Protection Ageancy)	Flood plain Laws and Regulations	✓			Duval County 2010 local mitigation strategy	
	FEMA (Fedral Emergency Managent Agency)	Executive Order 11988: Floodplain Management	✓			Duval County 2010 local mitigation strategy	
	IPCC (intergovermmental pannel for climate change)	Climate change 2013: The physical science basis					
f) Land-use planning	*FEMA (Fedral Emergency Managent Agency)*	Building Community Resilience by Integrating Hazard Mitigation: Integrating Hazard Mitigation Into the Local Comprehensive Plan	✓			State of Florida 2012 Comprehensive emergency management plan	(Jha, Miner and Zuzana 2013); (Philipsborn 2005)
		Policeis for guiding for Post-Disaster Recover and Reconstruction	✓			State of Florida 2012 Comprehensive emergency management plan	
		Landuse plannign for Hazard Mitigation					
		FEMA local mitigation planning Handbook for commmunity	✓			State of Florida 2012 Comprehensive emergency management plan	
		Local mitigation planning handbook					
	APA (American planning Association)	Hazard Mitigation: Integrating best practice into planning					
	USCOE (United states corps. Of engineering)	Future beach renourishment projects	✓			Duval County 2010 local mitigation strategy	

g) Disaster magement Framework	*FEMA (Fedral Emergency Management Agency)*	National response framework	✓			State of Florida 2012 Comprehensive emergency management plan	(Jha, Miner and Zuzana 2013)
h) Insurance and Funding	*FEMA (Fedral Emergency Management Agency)*	Recovery and Rebuild Program	✓			Duval County 2010 local mitigation strategy	(Jha, Miner and Zuzana 2013)
		The national Flood insurance program	✓				
	American Red Cross	Recovering Financially					
	The World Bank	Disaster risk managenent					
2) Community Preparedness Policies							
Awareness and Supplie management	*American Red Cross*	Redcross Emercency Preparedness Checklist					
	FEMA (Fedral Emergency Management Agency)	America's PrepareAthon: National Prepareness program	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
		Basic Preparedness Kit					
	CDC (Center for Disease Controle)	Emergency prepardness and response					
What to do?	*FEMA (Fedral Emergency Management Agency)*	Are You Ready? An in-depth Guide to Citizen Preparedness	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
	American Red Cross	Disaster preparedness for Seniors by seniors	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	

		Disaster and Saftey Library	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
	CDC (Center for disease controle)	Emergrncy Preparedness and Response					
3) Disaster Response							
a) Warning	*NASA (National Aeronautics and Space Administration)*	NASA GPS System for Hazard warning					(Jha, Miner and Zuzana 2013)
	UNISDR (United Nations. International Strategy for Disaster Reduction)	Developing Early Warning System: A Checklist					
		Guiding Principles for Effective Early Warning					
	USGS (United State Geological Survey)	Early Warning and Environmental Monitoring Program (EWEM)					
	ArcGIS (Esri's Geographic Information System)	Early warning System					
	NOAA	National Hurricane Center	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
b) Response team	*International Rescue Committes*	Emergency response relief team					(Philipsborn 2005)
	ASPCA (American Society for the Prevention of Cruelty to Animals)	Natural Disaster Rescue program					

	FEMA (Fedral Emergency management Agency)	Community Emergency Response Team	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
		National Incident Management Syatem					
c) Shelter facility	CDC (Center for disease controle)	Infection Control Guidance for Community Evacuation Centers Following Disasters					(Jha, Miner and Zuzana 2013); (Philipsborn 2005)
	FEMA (Fedral Emergency management Agency)	Risk Management Series: Design Guidance for Shelters and Safe Rooms FEMA 453					
	Pennsylvania, Emergency Management Agency	Disaster Preparedness Planning Guide For Facilities					
	Department of Homeland Security	Disaster Assistance Improvement Program (DAIP)					
	American Red Cross	Shelter Facility	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
d) Health Facilities	*CDC (Center for disease controle)*	Infection Control Guidance for Community Evacuation Centers Following Disasters					(Cutter, Boruff and Shirley, Social vulnarability to environmental hazard 2003); (PERI 2005)
	American Red Cross	Disaster Services	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	

	FEMA (Fedral Emergency management Agency)	Emergency Support Function #6 – Mass Care, Emergency Assistance, Temporary Housing, and Human Services Annex	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
	WHO (World health Organization)	Hospital Emergency Response Checklist					
	United States public health service	Disaster Inspections of Medical Facilities					
	National Association of Community Health Center	Assistance Before, During, and After Emergencies and Disasters					
	International Fedration of Red Cross	Emergency Health Servicce					
	Joint Commission	Standing Together: An Emergency Planning Guide for America's Communities					
e) Child Care facilities	NACCRRA (National Association of Child Care Resource & Referral Agencies)	Protecting Children in Child Care During Emergencies					(Jha, Miner and Zuzana 2013); (PERI 2005); (Cutter, Boruff and Shirley, Social vulnarability to environmental hazard 2003)
	National Institute of Health	Maternal health considerations during disaster relief					
	Office of Child Care	State Regulatory Requirements for Emergency Preparedness Planning					

	NH Child Development Bureau, Child Care Licensing Unit, Child Care Resource and Referral Network, NH Emergency Management of Department of Safety and Easter Seals NH.	Family Child Care Emergency Preparedness Guide					
	CDC (Center for Disease Controle)	Guidelines for the Management of Acute Diarrhea After a Disaster	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
	FEMA (Fedral Emergency management Agency)	Post-Disaster Reunification of Children: A Nationwide Approach					
	Department of Homland security	Supplemental Resource: Children in Disaster Guidance					
f) Communication Facilities	*Fedral Communication Commission*	TPS (Telecommunication Service Priority) Program	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan State wide Emergency Notification ICP (Interagency Coordinating Procedures)	(Jha, Miner and Zuzana 2013)
		GETS (Government Emergency Telecommunication Service)					
		WPS (Wireless Priority Service) Program					
g) Clean up	*SBA (US Small Business Administration)*	Guide to cleaning up saftely after a disaster					(Jha, Miner and Zuzana 2013); (PERI 2005)
		Cleaning and Sanitizing with Bleach After an Emergency					
		Cleaning Flood Contaminated HVAC Systems: A Guide for Building Owners and Managers					

		Dealing with Debris and Damaged Buildings					
		Disposing of Debris and Removing Hazardous Waste					
		After a Hurricane or Flood: Cleanup of Flood Water					
		Flood Cleanup Fact Sheet					
		Mold Cleanup in Schools and Commercial Buildings					
	CDC (Center for Disease Controle)	Flood Water After a Disaster or Emergency					
		Fact Sheet: Clean Up Safely After a Disaster					
	US EPA (US Environment protction Agency)	Planning for Disaster Debris	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
		Planning for Polychlorinated Biphenyl (PCB)-Containing Disaster Debris					
	FEMA (Fedral Emergency management Agency)	Debris Management Guide	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
4) Recovery and Reconstruction							
Short-Term and Long-Term Recovery Plans	*FEMA (Fedral Emergency management Agency)*	National Disaster Recovery Framework: Community Planning and Capacity Building Recovery Support Function					(Jha, Miner and Zuzana 2013); (PERI 2005)

		National Disaster Recovery Framework Strengthening Disaster Recovery for the Nation	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
		Policies for Guiding Planning for PostDisaster Recovery and Reconstruction	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
		Disaster Assistance: A Guide to Recovery Programs FEMA 229(4)					
		Continuity Plan template for Federal Departments and Agencies					
		Planning for Post-Disaster Recovery and Reconstruction					
		Long Term Community Recovery Planning Process: A Self-Help Guide	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
	American Red Cross	Disaster Recovery: A Guide to Financial Issues (A5076).	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
	EPA (Environmental Protection Agency)	American Recovery and Reinvestment Act (ARRA) of 2009					
		Beach Grants					
		Catalog of Federal Funding	✓			Consolidated City of Jacksonville/ Duval County, Florida: Comprehensive Emergency Management Plan	
		Clean Water State Revolving Fund					
		Drinking Water State Revolving Fund (DWSRF)					

		Federal Funding for Water/Wastewater Utilities in National Disasters (Fed FUNDS)					
		Safe Drinking Water Act					
		Watershed Funding					
	Public Entity Risk Institute	HOLISTIC DISASTER RECOVERY Ideas for Building Local Sustainability After a Natural Disaster					
	OECD (United states Organisation of Economic Co-operation and Development)	Building resilient regions: Lessons for policy making in post-disaster regions					
	DERA (Disaster preparedness and Emergency Response Association)	Colorado Flood recovery plan					
	American Red Cross	Disaster Recovery: A Guide to Financial Issues (A5076).					
		PICKING UP THE PIECES AFTER A DISASTER Important Steps for Your Safe and Speedy Recovery					
	IEG (Independent Evaluation Group) World Bank	Natural Disaster Response Lessons from Evaluations of the World Bank and Others					
Total no of issues under in each catagories			**18**	**0**	**0**		
Source: Produces by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA 2015							

Table 8 shows the Resiliency matrix of organizational infrastructure for Jacksonville FL and out of 18 issues identifies for addressing the resiliency in different phases of hazard management, city have addressed them all. This shows that city of Jacksonville have a well-defined and properly laid out hazard management program in their planning documents.

Resiliency in ecosystem management for Jacksonville FL

City of Jacksonville is located in the northeast corner of state of Florida. The main character of the city is St Johns River splitting the city into two parts. The city is characterized by low level coastal plain, interrupted by a series of ancient marine terraces. The city also comprises of considerable amount of fresh water marsh and swamps along with salt marshes. Also one of the most attractive natural assets of the city is the largest urban park system in the country. Also these marsh lands and riparian zone are home of numerous bacteria's, fishes and wildlife. But as per the research done by St. Johns River keeper, the integrity of the river system is threatened due to neglected and the cumulative impact of a growing population. The impacts are nutrient overload in the water and atmosphere, increase harmful bacteria's in water, continuous water withdrawal, sedimentation because of surface run-off, and over all habitat loss for wildlife (Riverkeeper 2011).

For having a resilient city it is equally important to balance the cycle of both human and natural ecosystem. Thus it is equally important to draft the policies for maintaining the resiliency in ecosystem. This next section of matrix will be testing the resiliency of planning document for ecosystem management for the city of Jacksonville FL.

Table 7-9 Resiliency matrix of ecosystem management for Jacksonville FL

Issues defining resilience of ecosystem	Measurment value	Planning documents of Jacksonville			Source of information	Possible sources for data availability	Documents referred
		Addressed	Not Addressed	Needs an update			
1) Climatic Change							
a) Extent of Ecosystem	Area	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan	Remote Sensing data	(EPA 2002)

b) Type of Ecosystem	landusedata	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan	Remote Sensing data	(EPA 2002)
c) Land-Use pattern/ Structure	Fragmentation pattern	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan	Remote Sensing data	(EPA 2002)
d) Composition of Ecosystem	Ex: wetland, Marsh, Coral reef	✓			Florida Department of Environmental Protection, Geological Survey	Remote Sensing data	(EPA 2002)
e) % Vegitated land and description	Percentage	✓			Florida Department of Environmental Protection, Geological Survey		
f) % agriculture land	Percentage	✓			Florida Department of Environmental Protection, Geological Survey		(Bank 2015)
g) % rural development	Percentage			✓	official website for city of Jacksonville, Zonining District Summries (http://www.coj.net/departments/planning-and-development/current-planning-division/zoning-district-summaries.aspx)		(Bank 2015)
h) % urban development	Percentage			✓	official website for city of Jacksonville, Zonining District Summries (http://www.coj.net/departments/planning-and-development/current-planning-division/zoning-district-summaries.aspx)		

i) Change in ecosystem composition	Percentage	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan		(EPA 2002)
j) Composition of Air	data			✓	official website for city of Jacksonville, Ambient Air Monitering activity (http://www.coj.net/departments/neighborhoods/environmental-quality/ambient-air-monitoring-activity.aspx)	Departmet of natural resource	(Bank 2015)
k) CO2 Emission	metric tons per capita			✓	official website for city of Jacksonville, Ambient Air Monitering activity (http://www.coj.net/departments/neighborhoods/environmental-quality/ambient-air-monitoring-activity.aspx)	Departmet of natural resource	(Bank 2015)
l) Nitrious oxide emission	metric tons per capita			✓	official website for city of Jacksonville, Ambient Air Monitering activity (http://www.coj.net/departments/neighborhoods/environmental-quality/ambient-air-monitoring-activity.aspx)	Departmet of natural resource	(Bank 2015)
m) Methane Emission	metric tons per capita			✓	official website for city of Jacksonville, Ambient Air Monitering activity (http://www.coj.net/departments/neighborhoods/environmental-quality/ambient-air-monitoring-activity.aspx)	Departmet of natural resource	(Bank 2015)

n) Green House gas emission (HFC, PFC and SF6)	metric tons per capita			✓	official website for city of Jacksonville, Ambient Air Monitering activity (http://www.coj.net/departments/neighborhoods/environmental-quality/ambient-air-monitoring-activity.aspx)	Departmet of natural resource	(Bank 2015)
o) Annual fresh air withdrawal	metric tons per capita			✓	official website for city of Jacksonville, Ambient Air Monitering activity (http://www.coj.net/departments/neighborhoods/environmental-quality/ambient-air-monitoring-activity.aspx)	Departmet of natural resource	(Bank 2015)
p) Electric power consumption	kWh per capita			✓	Jacksonville Electrical Authority	Energy information administration	(Bank 2015)
q) Energy power production	kWh per capita			✓	Jacksonville Electrical Authority		(EPA 2002)
s) Ground water flow	% impervious surface	✓			JEA Annual report,Water Quality and water conservation guide and hurricane prepardness 2012 ()file:///C:/Users/Shruti/Downloads/Water%20Quality%204%2013%20Final.pdf	land use data	(EPA 2002)
t) water quality		✓			JEA Annual report,Water Quality and water conservation guide and hurricane prepardness 2012 ()file:///C:/Users/Shruti/Downloads/Water%20Quality%204%2013%20Final.pdf		

u) Population growth	annual %	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan	Census data	(Bank 2015)
v) Total population	number	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan	Census data	(Bank 2015)
w) Rural population	% total population	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan	Census data	(Bank 2015)
x) Urban population		✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan	Census data	(Bank 2015)
y) Urban growth rate	% increase in grey surface	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan	Smart Grouth America, Measuring Sprawl 2014	(Bank 2015)
2) Effects of climate change							
a) Geomorphological studies	List of major changes			✓	Florida geographic data library, data source links (http://www.geoplan.ufl.edu/fgdl_source_links.htm)	NOAA	(EPA 2002)
b) Change in landscape	% increase or decrease on green cover			✓	Florida geographic data library, data source links (http://www.geoplan.ufl.edu/fgdl_source_links.htm)		(Bank 2015)

c) Change in vegetation type	List of major vegetation before and after			✓	Florida geographic data library, data source links (http://www.geoplan.ufl.edu/fgdl_source_links.htm)		(EPA 2002)
d) Effects in the agricltural production	% chage in agricultural production			✓	Florida geographic data library, data source links (http://www.geoplan.ufl.edu/fgdl_source_links.htm)		(Bank 2015)
e) Change in the natural buffers	% increase or decrease in the size of natural buffer	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan		(EPA 2002)
f) change in precipitation	Annual precipitation in mm			✓	JEA Annual report,Water Quality and water conservation guide and hurricane prepardness 2012 ()file:///C:/Users/Shruti/Downloads/Water%20Quality%204%2013%20Final.pdf		(EPA 2002)
g) Increase in temperature	Rise in temperature	✓					(Bank 2015)
h) Annual sea level rise	in mm	✓					(EPA 2002)
i) change in ground water level	in mm			✓	JEA Annual report,Water Quality and water conservation guide and hurricane prepardness 2012 ()file:///C:/Users/Shruti/Downloads/Water%20Quality%204%2013%20Final.pdf		(EPA 2002)

j) Change in water quality	components and their percentages in the water			✓	JEA Annual report,Water Quality and water conservation guide and hurricane prepardness 2012 ()file:///C:/Users/Shruti/Downloads/Water%20Quality%204%2013%20Final.pdf		(Bank 2015)
k) Different natural events observed	list of events	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan		
l) Frequency of the natural event	Number	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan		(Bank 2015)
m) Intensity of the natural events	distruction caused by event	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan		(Bank 2015)
n) Zone of impact for the natural events	Area effected by the natural event	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan		(EPA 2002)
3) Policies							
a) Land use plans	Document	✓			* Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan * 2030 Comprehensive plan, Future landuse element, Jacksonville	FEMA	

b) Zoning ordinance	Document	✓			* Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan * 2030 Comprehensive plan, Future landuse element, Jacksonville	FEMA	
c) Construction standerds	Document	✓			The Florida Department of Environmental Protection DIVISION OF BEACHES AND COASTAL SYSTEMS, The home owners guide to coastal construction controle line program (section 161.053, Florida statutes)	FEMA	(Scott Tezak; David K. Low; Adam Reeder 2009)
d) Clean air act	Document	✓			Florida Department of environmental protection, Clean air act (rules and forms)	EPA	(EPA, Air Pollution and the Clean Air Act 2013)
e) Clean water act	Document	✓			Handbook for Florida water regulations: Clean water act	EPA	(EPA, Clean Water Act (CWA) Compliance Monitoring 2015)
f) Shoreline protection act	Document	✓			Waterfront property owners guide (Florida department of environmental protection)	EPA	(EPA, Lake Shoreland Protection Resources: Clearinghouse for Information on Lakeshore Protection and Restoration 2014)
g) Ecosystem management program	Document	✓			Florida Environmental protection statutes 2012	IUCN (International Union of Conservation of Nature)	(IUCN 2014)
h) Green power partnership	Document	✓			Florida Planning toolbox	EPA	(EPA, Green power Partnership 2015)
i) Heat island reduction initiative	Document	✓			Florida Planning toolbox	EPA	(EPA, Reducing Urban Heat Islands: Compendium of Strategies 2013)
j) Clean power plan toolbox for state	Document	✓			Florida Planning toolbox	EPA	(EPA, Clean Power Plan Toolbox for States 2014)

k) Mitigation Ideas: A resource for reducing risk to natural hazards	Document	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan	FEMA	(Baxter, et al. 2013)
l) Coastal mapping	Document	✓			Consolidated city of Jacksonville/ Duval County, Florida comprehensive emergency management plan	FEMA	(FEMA n.d.)
Total no of issues under in each catagories		**34**	**0**	**18**			
Source: Produces by Shruti Agrawal , Masters of Environment + Design candidate, CED @UGA							

Table 9 shows the resilience matrix of ecosystem management for city. Although out of 52 issues identified for the resilience of ecosystem management, there is not a single issue that have not been addressed, but 18 issue need some attention in terms of being properly addressed in the planning documents. 34 issues out of 52 were addressed properly in the planning documents. Thus out of all issues, Jacksonville FL really need to focus on updating their plans for ecological resiliency for having a better and sustainable protection system.

The next section is measuring the socio economic resiliency of the place. Since it was difficult to develop a measuring tool for calculating the dependencies for people on economy of city and visa-versa after a natural event, this section is discussed on the basis of implied theories.

7.5 Socio-Economic impact of disaster on Savannah and Jacksonville

To understand the socio economic impact, firstly it is important to understand the major economic center of the city, its composition and it's functioning. Secondly, understanding the social composition if the city and their interdependencies. For Savannah, according to

Savannah Area Chamber of Commerce, have multi tired economic activities. These are, tourism, the port, manufacturing, military, film, retail and services. Having a multi layers economy is beneficial because it prevents the complete crash of economy at any given point, but it is still it is import to evaluate the impact on the economic activities due to natural event to resume the normal functioning of the city. In case of Savannah, the city is missing policies for tourist evacuation, education and public outreach programs, early evacuation plan for the critical population, affordable insurance plan. These missing gaps in policies for demography can be both positive and negative effect on economy. For sake of discussion, if a hurricane hits Savannah and there is no previous warning system or evacuation plan for tourist, it might impact the tourism industry for the place. Since for Savannah, tourism and hospitality are the greatest economic driver of the country, it is important to factor consideration for them. Any loss in infrastructure in the hospitality industry will not only create a huge state of unemployment, but also will impact the economy from tourism industry, till the time the activities are restored and healthy to use. But at the same time the missing policies on critical population and emergency medical care during the time of disaster, will although increase the mortality and loss of human life, but at the end will decrease the dependency ratio (i.e. no of people depending on government pension divided by no of people earning). This thought is definitely unethical but from utilitarian's perspective it's profitable for government and its investment, especially in a city where approximately 37% of population are critical population (which includes, kids, adults and elderly's with physical or mental disabilities). But another important observation from infrastructure point of view is the missing policies for calculating the impact on water quality due to disaster event. This can create a huge social and economic impact on the city. This can result in major health hazard for the people which

will impact the economy by lack of enough work force to finish tacks, also it will require a huge economic investment to upgrade the water supply system. Thus it is important to understand at least the socio economic impact of the identified missing portions of the planning documents. Since it is beyond the scope of this project and my understanding on the subject, I am going to end the discussion about the socio economic impact till the identified issues only.

Now the city of Jacksonville FL, also have a multilayer of economy similar to Savannah. These are port, mill, tourism, manufacturing, retail and services, navy, power, agriculture and natural resource industry. Because of existence of so many economic centers, city is economically resilient toward the impact of any major natural disaster. Also city have well updated plans for the resiliency of its infrastructure and different demographic groups, which at least theoretically assures that there would be a smooth and early recovery from the impact of natural event which would mitigate the socio economic impact of disaster.

Thus this is how the applicability of the resiliency matrix can be tested. These results are very calculative, thus can really help in understanding the status of planning documents of different cities. Also since the matrix helps in identifying specific missing issues from the planning documents, it will be a helpful tool for the city government to identify such issues and work on updating those sections only. But for now for the selected cities of Savannah, GA, and Jacksonville, FL, obviously Jacksonville have a better laid out planning document for resisting the disturbance caused due to any natural event. Although Savannah also have a good planning documents available, but it still need to work on adding and updating few sections, to be in a better position to bounce back from damage caused by a natural event.

Since Savannah GA, and Jacksonville FL have very similar situations, a lot of policies laid out in the planning documents of Jacksonville can be adopted by Savannah too.

8. CONCLUSION AND CONTINUATION

8.1 Resiliency score of Savannah GA and Jacksonville FL

As observed in previous chapter, both Savannah and Florida have a well-defined hazard management plan, but since in the state of Georgia it not mandatory to have such a plans in coastal cities for events like flood, sea level rise, and hurricanes, the flood management plan and comprehensive plans of the city is missing few sections of it. With the limited resource and man power available with county governments and cities, identification of such missing issues can be really helpful, so that they can work on updating those specific sections only.

At the end for the purpose of study, I would calculating the resiliency score to both the cities just so to show how well cities are doing in doing there mitigation planning. Also once similar study be done on the other coastal counties of the states, their progress report can be compared and evaluated. So in order to properly evaluated the resiliency score for the cities, I have assigned 1 point to each issues identified for the resiliency matrix. If the city has addressed the issues properly 1 point is assigned to that, it the issues need an update than 0.5 points are assigned, and if the city is missing to address a particular information no points are assigned of that. There can be a better system for normalizing the points for the issues “that needs an update” , based on the severity of the issues and the impact improving that section on the resiliency of the city towards the natural events. But that is a wider scope of study and cannot be completed in this research considering the time constrains and original scope of the research. So a simple method of providing half a point for incomplete information is adopted.

Working with this scoring system, following are the final resiliency scores for the city of Savannah and Jacksonville.

Savannah, GA

Total identified issues 143 including Demographic resilience, resiliency of urban infrastructure, and resiliency of ecosystem management.

No of issues addressed in the planning documents: 96 (Demographic: 36, Physical infrastructure: 14, Organizational infrastructure: 16, and Ecosystem management: 30)

No. of issues needs and update in the planning documents: 34 (Demographic: 12, Physical infrastructure: 03, Organizational infrastructure: 01, and Ecosystem management: 18)

No of issues that are not addressed in the reviewed planning documents: 13 (Demographic: 06, Physical infrastructure: 02, Organizational infrastructure: 01, and Ecosystem management: 04

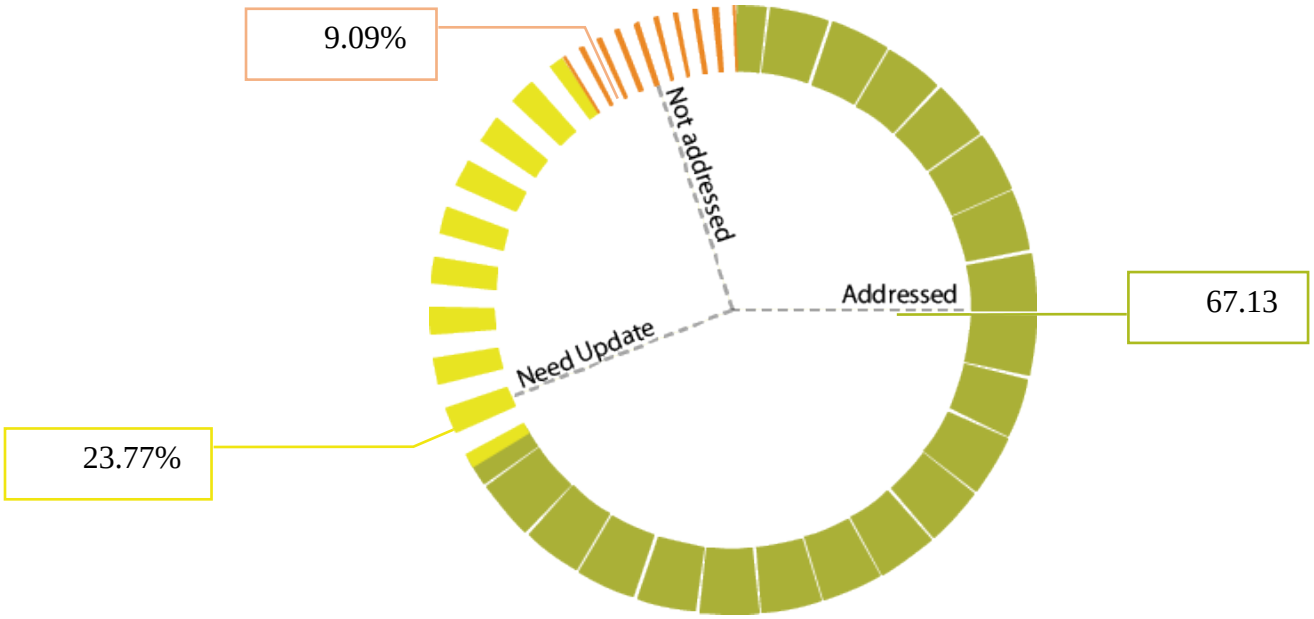


Figure 9 Chart Showing the percentage of issues that are addressed, not addressed and needs an update for the city of Savannah

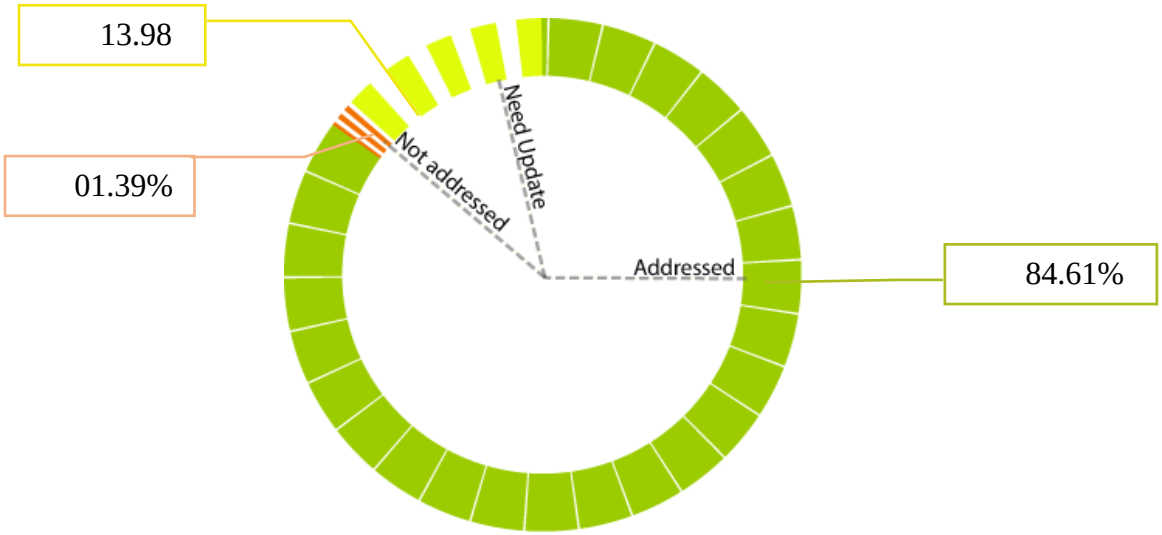
Now based on above results, calculating the Resiliency score for savannah

Total no of identified issues: 143 i.e. total of 143 points, no of issues addressed is 96 that is total of 96 points, no of issues needs as update are 34, that gives total point of 17. Thus resiliency score for Savannah will be:

$$\frac{\mathbf{96 + 17}}{\mathbf{143}} \times \mathbf{100 = 79.02}\%$$

That means the planning documents of Savannah is 79.02% resilient to sustain the disturbance and regain its functioning after the impact of natural events like flood, sea-level rise, tropical storms and hurricanes. The missing 21% can be updated using the planning documents of the neighboring counties or Jacksonville, whose resilience score is calculate in the next section.

Jacksonville, FL



No of issues addressed in the planning documents: 122 (Demographic: 53, Physical

Figure 11 Chart Showing the percentage of issues that are addressed, not addressed and needs an update for the city of Jacksonville

infrastructure: 17, Organizational infrastructure: 18, and Ecosystem management: 34)

No. of issues needs and update in the planning documents: 20 (Demographic: 00, Physical infrastructure: 02, Organizational infrastructure: 00, and Ecosystem management: 18)

No of issues that are not addressed in the reviewed planning documents: 01 (Demographic: 01, Physical infrastructure: 00, Organizational infrastructure: 00, and Ecosystem management: 00)

Now based on above results, calculating the Resiliency score for Jacksonville:

Total no of identified issues: 143 i.e. total of 143 points, no of issues addressed is 121 that is total of 121 points, no of issues needs as update are 20, that gives total point of 10. Thus resiliency score for Savannah will be:

$$\frac{\mathbf{122 + 10}}{\mathbf{143}} \times \mathbf{100} = \mathbf{92.30}\%$$

That means the planning documents of Jacksonville is 92.30% resilient to sustain the disturbance and regain its functioning after the impact of natural events like flood, sea-level rise, tropical storms and hurricanes. Although the planning documents of the city of Jacksonville is not 100% resilient but it's still in a great to sustain the disturbance caused by any natural event.

8.2 Assumptions and future implications

The creation and implication of this resiliency matrix was and still is a vast topic. The following resiliency matrix was created by referring maximum of 5-8 resources per topic for demography, urban infrastructure, organizational infrastructure, and ecosystem management. Although considering time and available free resource as a limiting factor, it was impossible to identify each and every factors for defining the resiliency, but the purpose of this research was to explain and emphasis the importance and usability of such matrix that can be created to evaluate the planning document for a particular natural event. This would not only help city to sustain through the disaster but will help in smooth and systematic recovery process.

The Scores allotted to the cities are not the final scores. These are the scores based on the available documents from state, county, and cities website. Any missing data or updated are welcome to be incorporated in this research. But the important issue discussed in this practicum was to show the application of such matrix on the planning documents of two smiler cities and understand how cities and counties can work together for increasing their resiliency. Also the framework of resiliency matrix can be used for updating the planning documents.

Further research can be done on this subject to enhance the matrix by identifying and adding more issues in the matrix for making it more specific for different natural events. Also a standardize calculation method can be created to incorporate the measurement of socio-economic factors in the resiliency matrix.

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APPENDIX E

Data Report Pursuant to Chapter 110-12-6-.07

Population

Total Population

From 2000 to 2010 the region's population grew by 15%. All of the counties gained population except Screven County. Bryan, Bulloch, Effingham, Long, and McIntosh Counties all grew more than the regional average. All counties are projected to grow between the 2000 census and 2030, with a projected regional growth rate of 42%. Bryan, Bulloch, Camden, Effingham, and McIntosh Counties are projected to grow faster than the regional average. See Table 1.

Table 1
Population Growth and Projected Growth by County

County	2000	2010	% Change 2000-2010	annualized	2020	2030	% Change 2000-2030
Bryan	23,417	30,233	23%	2.25%	45,272	59,534	61%
Bulloch	55,983	70,217	20%	2.03%	88,071	109,034	49%
Camden	43,664	50,513	14%	1.36%	70,548	96,743	55%
Chatham	232,048	265,128	12%	1.25%	290,615	324,098	28%
Effingham	37,535	52,250	28%	2.82%	80,563	112,062	67%
Glynn	67,568	79,626	15%	1.51%	93,461	109,771	38%
Liberty	61,610	63,453	3%	0.29%	78,740	93,821	34%
Long	10,304	14,464	29%	2.88%	14,386	17,171	40%
McIntosh	10,847	14,333	24%	2.43%	16,039	20,686	48%
Screven	15,374	14,593	-5%	-0.54%	17,819	20,036	23%
CRC Region	**560,350**	**656,820**	**15%**	**1.47%**	**797,534**	**964,986**	**42%**

Source: U. S. Census, GA Office of Planning & Budget

In addition to looking at the population data for the Coastal Region's counties, we also examined the population for all twelve Regional Commissions within the state. From 2000 to 2010, the Coastal Region ranked third in population and sixth in population growth. Based upon population projections by the Georgia Office of Planning & Budget, the Coastal

Region will rank 5th in population and remain at 6th in projected population growth. See Table 2.

Table 2
Population Growth and Projected Growth by Region

Region	2000	2010	% Change 2000-2010	annualized	2020	2030	% Change 2000-2030
Coastal Georgia	**558,350**	**654,810**	**15%**	**1.47%**	**795,514**	**962,956**	**42%**
Northwest Georgia	697,410	873,296	20%	2.01%	1,085,667	1,348,614	48%
Georgia Mountains	455,342	646,300	30%	2.95%	867,596	1,158,531	61%
Atlanta Region	3,429,379	4,402,352	22%	2.21%	5,286,948	6,313,176	46%
Northeast Georgia	438,300	607,030	28%	2.78%	796,704	1,043,762	58%
Three Rivers	403,944	509,199	21%	2.07%	644,868	807,012	50%
Middle Georgia	440,121	489,491	10%	1.01%	560,713	635,838	31%
Central Savannah River	419,634	450,292	7%	0.68%	515,785	582,973	28%
River Valley	353,274	365,648	3%	0.34%	418,200	471,121	25%
Heart of GA Altamaha	272,894	299,874	9%	0.90%	337,026	375,230	27%
Southwest Georgia	341,910	364,697	6%	0.62%	409,456	455,882	25%
Southern Georgia	173,780	187,717	7%	0.74%	215,873	245,033	29%
Georgia	**7,984,338**	**9,850,706**	**19%**	**1.89%**	**11,934,350**	**14,400,128**	**45%**
CRC Ranking	**3**	**3**	**6**	**6**	**5**	**5**	**6**

Source: U. S. Census, GA Office of Planning & Budget

Age Distribution

In the Regional Assessment, we looked at two vulnerable populations, the very young (under 5) and the elderly (65 and over)in our discussion of Resiliency. The following data demonstrates the shift in ages by county and by the region as a whole.

From 2000 to 2010, the regional average of the median age changed by 2.6 years from 31.8 years old to 34.4 years old, an 8% increase. Not all counties shifted in the same direction however; Bulloch and Chatham Counties now have lower median ages by nearly 1%, while the median ages in Camden, Liberty, Long, and McIntosh Counties were moving higher than the 8% average for the region. McIntosh County now has the highest median age in the region, 44.4 years old, representing an increase of 20%. See Table 3 below.

Table 3 Shift in Median Age – 2000 to 2010				
County	**Median Age 2000**	**Median Age 2010**	**Change**	**Percent Change**
Bryan	33.3	35.7	2.4	7.21%
Bulloch	26.1	25.9	-0.2	-0.77%
Camden	*28.2*	*31.3*	*3.1*	*10.99%*
Chatham	34.4	34	-0.4	-1.16%
Effingham	33.6	35.1	1.5	4.46%
Glynn	37.9	39.4	1.5	3.96%
Liberty	*25*	*27.9*	*2.9*	*11.60%*
Long	*26.5*	*30.6*	*4.1*	*15.47%*
McIntosh	*37*	*44.4*	*7.4*	*20.00%*
Screven	*36.2*	*39.5*	*3.3*	*9.12%*
Regional Average	**31.8**	**34.4**	**2.6**	**8.05%**
Source: U. S. Census and CRC				

In addition to changes in the median age, the adult population (ages 18+) has grown by 85,500, nearly 21%, in the region from 2000 to 2010. Several counties grew at a much faster rate, with Effingham, Long, and McIntosh Counties all gaining more than 40% in adult population during the decade. Only Screven County saw its adult population drop. See Table 4 below.

Table 4 Shift in Population Ages 18+ – 2000 to 2010				
County	**Ages 18+ 2000**	**Ages 18+ 2010**	**Change**	**Percent Change**
Bryan	*16,128*	*21,376*	*5,248*	*32.54%*
Bulloch	*43,503*	*55,824*	*12,321*	*28.32%*
Camden	*29,832*	*36,861*	*7,029*	*23.56%*
Chatham	173,965	205,121	31,156	17.91%
Effingham	*26,301*	*37,344*	*11,043*	*41.99%*
Glynn	50,460	60,395	9,935	19.69%
Liberty	41,916	44,262	2,346	5.60%
Long	*6,893*	*10,045*	*3,152*	*45.73%*
McIntosh	*7,805*	*11,255*	*3,450*	*44.20%*
Screven	11,083	10,903	-180	-1.62%
Regional Total	**407,886**	**493,386**	**85,500**	**20.96%**
Source: U. S. Census and CRC				

Nationally, one of the fastest growing populations is the group known as the Baby Boomers. These are people born between 1945 and 1964. This group reached age 65 just in time for the 2010 census. Reported below is the change in population for ages 65 and older. Regionally this age cohort grew by 14,758, just over 25%. In some counties, notably Camden and McIntosh, the 65+ population doubled. Bryan, Effingham, Liberty, and Long Counties all show very robust growth in the 65+ population. See Table 5 below.

Table 5
Shift in Population Ages 65+ – 2000 to 2010

County	Ages 65+ 2000	Ages 65+ 2010	Change	Percent Change
Bryan	*1,703*	*2,715*	*1,012*	*59.42%*
Bulloch	5,207	6,401	1,194	22.93%
Camden	*2,277*	*4,556*	*2,279*	*100.09%*
Chatham	29,770	32,864	3,094	10.39%
Effingham	*3,016*	*4,763*	*1,747*	*57.92%*
Glynn	9,761	11,976	2,215	22.69%
Liberty	*2,432*	*3,971*	*1,539*	*63.28%*
Long	*594*	*1,055*	*461*	*77.61%*
McIntosh	*1,280*	*2,478*	*1,198*	*93.59%*
Screven	2,155	2,174	19	0.88%
Regional Total	**58,195**	**72,953**	**14,758**	**25.36%**

Source: U. S. Census and CRC

Race and Ethnicity

Examining the region as a whole, the racial and ethnic composition has remained very similar between 2000 and 2010 when looking at race or ethnicity as a percentage of the whole population. The percentage of the population reporting as "One race," "White," or "Black or African-American" have decreased by approximately one percent, while the percentage of the population reporting as "Some other race" or "Two or more races" has gone up by a similar amount. The most significant increase is the percentage of the population reporting as "Hispanic or Latino" which has grown by 2.37% from 3.08% to 5.45% of the regional population. When you look at the actual numerical growth of some populations, the percentage seems much more dramatic. For example the number of Asians has grown by 65%, Native Hawaiian and other Pacific Islanders has grown by 77%, and Hispanics or Latinos has grown by 108%. However, these groups, even when combined, represent less than 10% of the total population. See Table 6 below.

Table 6
Trends in Race and Ethnicity 2000 to 2010

Coastal Region	2000	Percent Total Population	2010	Percent Total Population	Numerical Change	Percent Change
Total Population	558,350	100.00%	654,810	100.00%	96,460	17%
One race	550,240	98.55%	639,459	97.66%	89,219	16%
White	349,086	62.52%	401,724	61.35%	52,638	15%
Black or African American	184,767	33.09%	209,579	32.01%	24,812	13%
American Indian and Alaska Native	1,698	0.30%	2,167	0.33%	469	28%
Asian	6,887	1.23%	11,353	1.73%	4,466	65%
Native Hawaiian and Other Pacific Islander	564	0.10%	999	0.15%	435	77%
Some other race	7,238	1.30%	13,637	2.08%	6,399	88%
Two or more races	8,110	1.45%	15,351	2.34%	7,241	89%
Total Population	558,350	100.00%	654,810	100.00%	96,460	17%
Hispanic or Latino (of any race)	17,193	3.08%	35,706	5.45%	18,513	108%
Not Hispanic or Latino	541,157	96.92%	619,104	94.55%	77,947	14%
Source: U. S. Census and CRC						

When we compare the Coastal Georgia region to the United States and to the State of Georgia, we find that the region has a significantly higher percentage of Blacks or African-Americans than the country as a whole and a slightly higher percentage than the state. The region's Asian and Hispanic or Latino populations are significantly lower than the country or the state.

- Black or African-American – United States (12.6%), Georgia (30.7%), Coastal Georgia (32.01%);
- Hispanic or Latino – United State (16.6%), Georgia (8.9%), Coastal Georgia (5.45%); and
- Asian – United States (4.9%), Georgia (3.4%), Coastal Georgia (1.73%).

The Race and Ethnicity data for the ten counties with the Coastal Region is reported below. Much like the region as a whole the shifts in demographics have been subtle and incremental. See Tables 7.1 through 7.10 below. The top three counties for representative minority populations are:

- Black or African American – Screven (43.29%), Liberty (42.24%), and Chatham (40.13%);
- Hispanic or Latino – Long (12.29%), Liberty (9.71%), and Glynn (6.44%); and
- Asian – Chatham (2.38%), Liberty (1.97%), and Bryan (1.61%).

Table 7.1 Bryan County	**2000**	**Percent Total Population**	**2010**	**Percent Total Population**	**Numerical Change**	**Percent**
Total Population	23,417	100.00%	30,233	100.00%	6,816	29%
One race	23,103	98.66%	29,475	97.49%	6,372	28%
White	19,386	82.79%	24,254	80.22%	4,868	25%
Black or African American	3,311	14.14%	4,286	14.18%	975	29%
American Indian and Alaska Native	74	0.32%	98	0.32%	24	32%
Asian	181	0.77%	486	1.61%	305	169%
Native Hawaiian and Other Pacific Islander	16	0.07%	25	0.08%	9	56%
Some other race	135	0.58%	326	1.08%	191	141%
Two or more races	314	1.34%	758	2.51%	444	141%
Total Population	23,417	100.00%	30,233	100.00%	6,816	29%
Hispanic or Latino (of any race)	465	1.99%	1,336	4.42%	871	187%
Not Hispanic or Latino	22,952	98.01%	28,897	95.58%	5,945	26%
Source: U. S. Census and CRC						

Table 7.2 Bulloch County	2000	Percent Total Population	2010	Percent Total Population	Numerical Change	Percent
Total Population	55,983	100.00%	70,217	100.00%	14,234	25%
One race	55,555	99.24%	69,056	98.35%	13,501	24%
White	38,460	68.70%	47,215	67.24%	8,755	23%
Black or African American	16,101	28.76%	19,409	27.64%	3,308	21%
American Indian and Alaska Native	72	0.13%	183	0.26%	111	154%
Asian	461	0.82%	1,020	1.45%	559	121%
Native Hawaiian and Other Pacific Islander	15	0.03%	64	0.09%	49	327%
Some other race	446	0.80%	1,165	1.66%	719	161%
Two or more races	428	0.76%	1,161	1.65%	733	171%
Total Population	55,983	100.00%	70,217	100.00%	14,234	25%
Hispanic or Latino (of any race)	1,052	1.88%	2,439	3.47%	1,387	132%
Not Hispanic or Latino	54,931	98.12%	67,778	96.53%	12,847	23%
Source: U. S. Census and CRC						

Table 7.3 Camden County	2000	Percent Total Population	2010	Percent Total Population	Numerical Change	Percent
Total Population	43,664	100.00%	50,513	100.00%	6,849	16%
One race	42,841	98.12%	48,982	96.97%	6,141	14%
White	32,765	75.04%	37,557	74.35%	4,792	15%
Black or African American	8,783	20.11%	9,799	19.40%	1,016	12%
American Indian and Alaska Native	216	0.49%	259	0.51%	43	20%
Asian	441	1.01%	724	1.43%	283	64%
Native Hawaiian and Other Pacific Islander	37	0.08%	76	0.15%	39	105%
Some other race	599	1.37%	567	1.12%	-32	-5%
Two or more races	823	1.88%	1,531	3.03%	708	86%
Total Population	43,664	100.00%	50,513	100.00%	6,849	16%
Hispanic or Latino (of any race)	1,585	3.63%	2,590	5.13%	1,005	63%
Not Hispanic or Latino	42,079	96.37%	47,923	94.87%	5,844	14%
Source: U. S. Census and CRC						

Table 7.4 Chatham County	2000	Percent Total Population	2010	Percent Total Population	Numerical Change	Percent
Total Population	232,048	100.00%	265,128	100.00%	33,080	14%
One race	229,067	98.72%	259,429	97.85%	30,362	13%
White	128,279	55.28%	140,010	52.81%	11,731	9%
Black or African American	93,971	40.50%	106,392	40.13%	12,421	13%
American Indian and Alaska Native	580	0.25%	691	0.26%	111	19%
Asian	4,013	1.73%	6,311	2.38%	2,298	57%
Native Hawaiian and Other Pacific Islander	151	0.07%	254	0.10%	103	68%
Some other race	2,073	0.89%	5,771	2.18%	3,698	178%
Two or more races	2,981	1.28%	5,699	2.15%	2,718	91%
Total Population	232,048	100.00%	265,128	100.00%	33,080	14%
Hispanic or Latino (of any race)	5,403	2.33%	14,370	5.42%	8,967	166%
Not Hispanic or Latino	226,645	97.67%	250,758	94.58%	24,113	11%
Source: U. S. Census and CRC						

Table 7.5 Effingham County	2000	Percent Total Population	2010	Percent Total Population	Numerical Change	Percent
Total Population	37,535	100.00%	52,250	100.00%	14,715	39%
One race	37,145	98.96%	51,270	98.12%	14,125	38%
White	31,776	84.66%	43,182	82.64%	11,406	36%
Black or African American	4,876	12.99%	7,048	13.49%	2,172	45%
American Indian and Alaska Native	119	0.32%	156	0.30%	37	31%
Asian	170	0.45%	427	0.82%	257	151%
Native Hawaiian and Other Pacific Islander	9	0.02%	26	0.05%	17	189%
Some other race	195	0.52%	431	0.82%	236	121%
Two or more races	390	1.04%	980	1.88%	590	151%
Total Population	37,535	100.00%	52,250	100.00%	14,715	39%
Hispanic or Latino (of any race)	531	1.41%	1,501	2.87%	970	183%
Not Hispanic or Latino	37,004	98.59%	50,749	97.13%	13,745	37%
Source: U. S. Census and CRC						

Table 7.6 Glynn County	2000	Percent Total Population	2010	Percent Total Population	Numerical Change	Percent
Total Population	67,568	100.00%	79,626	100.00%	12,058	18%
One race	66,832	98.91%	78,196	98.20%	11,364	17%
White	47,746	70.66%	53,823	67.59%	6,077	13%
Black or African American	17,874	26.45%	20,726	26.03%	2,852	16%
American Indian and Alaska Native	177	0.26%	232	0.29%	55	31%
Asian	408	0.60%	921	1.16%	513	126%
Native Hawaiian and Other Pacific Islander	32	0.05%	95	0.12%	63	197%
Some other race	595	0.88%	2,399	3.01%	1,804	303%
Two or more races	736	1.09%	1,430	1.80%	694	94%
Total Population	67,568	100.00%	79,626	100.00%	12,058	18%
Hispanic or Latino (of any race)	2,019	2.99%	5,126	6.44%	3,107	154%
Not Hispanic or Latino	65,549	97.01%	74,500	93.56%	8,951	14%
Source: U. S. Census and CRC						

Table 7.7 Liberty County	2000	Percent Total Population	2010	Percent Total Population	Numerical Change	Percent
Total Population	61,610	100.00%	63,453	100.00%	1,843	3%
One race	59,535	96.63%	60,493	95.34%	958	2%
White	28,737	46.64%	29,881	47.09%	1,144	4%
Black or African American	26,396	42.84%	26,805	42.24%	409	2%
American Indian and Alaska Native	322	0.52%	358	0.56%	36	11%
Asian	1,082	1.76%	1,247	1.97%	165	15%
Native Hawaiian and Other Pacific Islander	266	0.43%	392	0.62%	126	47%
Some other race	2,732	4.43%	1,810	2.85%	-922	-34%
Two or more races	2,075	3.37%	2,960	4.66%	885	43%
Total Population	61,610	100.00%	63,453	100.00%	1,843	3%
Hispanic or Latino (of any race)	5,022	8.15%	6,159	9.71%	1,137	23%
Not Hispanic or Latino	56,588	91.85%	57,294	90.29%	706	1%
Source: U. S. Census and CRC						

Table 7.8 Long County	2000	Percent Total Population	2010	Percent Total Population	Numerical Change	Percent
Total Population	10,304	100.00%	14,464	100.00%	4,160	40%
One race	10,111	98.13%	13,974	96.61%	3,863	38%
White	7,049	68.41%	9,026	62.40%	1,977	28%
Black or African American	2,499	24.25%	3,647	25.21%	1,148	46%
American Indian and Alaska Native	75	0.73%	91	0.63%	16	21%
Asian	59	0.57%	115	0.80%	56	95%
Native Hawaiian and Other Pacific Islander	26	0.25%	56	0.39%	30	115%
Some other race	403	3.91%	1,039	7.18%	636	158%
Two or more races	193	1.87%	490	3.39%	297	154%
Total Population	10,304	100.00%	14,464	100.00%	4,160	40%
Hispanic or Latino (of any race)	870	8.44%	1,778	12.29%	908	104%
Not Hispanic or Latino	9,434	91.56%	12,686	87.71%	3,252	34%
Source: U. S. Census and CRC						

Table 7.9 McIntosh County	2000	Percent Total Population	2010	Percent Total Population	Numerical Change	Percent
Total Population	10,847	100.00%	14,333	100.00%	3,486	32%
One race	10,753	99.13%	14,156	98.77%	3,403	32%
White	6,654	61.34%	8,811	61.47%	2,157	32%
Black or African American	3,993	36.81%	5,149	35.92%	1,156	29%
American Indian and Alaska Native	41	0.38%	53	0.37%	12	29%
Asian	32	0.30%	45	0.31%	13	41%
Native Hawaiian and Other Pacific Islander	4	0.04%	10	0.07%	6	150%
Some other race	29	0.27%	88	0.61%	59	203%
Two or more races	94	0.87%	177	1.23%	83	88%
Total Population	10,847	100.00%	14,333	100.00%	3,486	32%
Hispanic or Latino (of any race)	99	0.91%	227	1.58%	128	129%
Not Hispanic or Latino	10,748	99.09%	14,106	98.42%	3,358	31%
Source: U. S. Census and CRC						

Table 7.10 Screven County	2000	Percent Total Population	2010	Percent Total Population	Numerical Change	Percent
Total Population	15,374	100.00%	14,593	100.00%	-781	-5%
One race	15,298	99.51%	14,428	98.87%	-870	-6%
White	8,234	53.56%	7,965	54.58%	-269	-3%
Black or African American	6,963	45.29%	6,318	43.29%	-645	-9%
American Indian and Alaska Native	22	0.14%	46	0.32%	24	109%
Asian	40	0.26%	57	0.39%	17	43%
Native Hawaiian and Other Pacific Islander	8	0.05%	1	0.01%	-7	-88%
Some other race	31	0.20%	41	0.28%	10	32%
Two or more races	76	0.49%	165	1.13%	89	117%
	15,374	100.00%	14,593	100.00%		
Total Population	15,374	100.00%	14,593	100.00%	-781	-5%
Hispanic or Latino (of any race)	147	0.96%	180	1.23%	33	22%
Not Hispanic or Latino	15,227	99.04%	14,413	98.77%	-814	-5%
Source: U. S. Census and CRC						

Income

This section evaluates income levels, income distribution and poverty levels in the region and compares them to the State of Georgia and national data. The poverty rate for families in Coastal Georgia ranges from a low of 7.9% in Effingham County to a high of 21% in Screven County. The poverty rate for persons in Coastal Georgia ranges from a low of 11.2% in Effingham County to a high of 31.3% in Bulloch County. The poverty rate for persons in the State of Georgia is 18.2% and in the United States it is 15.4%. Bulloch, Chatham, Glynn, Liberty, Long, and Screven Counties all have a poverty rate higher than the State of Georgia. Additionally, Camden County has a poverty rate higher than the national rate. Only Bryan, Effingham, and McIntosh Counties have poverty rates lower than both the state and national rates. See Table 8 below.

Table 8
Poverty Rate for Families and Persons by County

County	Families	Persons
Bryan	8.60%	11.70%
Bulloch	16.30%	31.30%
Camden	13.70%	15.50%
Chatham	13.50%	19.10%
Effingham	7.90%	11.20%
Glynn	15.30%	19.20%
Liberty	15.60%	18.70%
Long	17.00%	19.20%
McIntosh	10.50%	14.90%
Screven	21.00%	27.00%
CRC Average	**19.94%**	**18.78%**
State of Georgia		**18.20%**
United States		**15.40%**

Source: American Community Survey 2013 - Economic Characteristics

Median Family Income (MFI) is that mid-point where half of family incomes are higher and half of family incomes are lower than that particular figure. Many social programs, especially state and federal housing and community development programs use the figure for median income for a family of four as the starting point to establish income limits that qualify families for various types of assistance based upon need. These figures are adjusted

upward and downward depending on family size. The U. S. Department of Housing and Urban Development (HUD) publishes tables on an annual basis listing the MFI for every Metropolitan Statistical Area (MSA), HUD Metro Fair Market Rent Area (HMFA), and rural county by state. These tables also show the Low- and Moderate-Income (LMI) thresholds for each area, along with calculations for Very-Low Income (VLI) and Extremely-Low Income (ELI); with low-income being 80% of MFI, very-low income being 50% of MFI and extremely-low income being 30% of MFI.

MFI ranges from $48,700 in Liberty County to $65,400 in Camden County. By comparison, MFI for the State of Georgia is $58,755 and for the United States it is $64,719. See Table 9 below.

Table 9
Median Family Income

MSA, HMFA, or Rural	County	MFI	L/M Threshold
Savannah, GA MSA	Bryan	$61,300	$49,040
Savannah, GA MSA	Chatham	$61,300	$49,040
Savannah, GA MSA	Effingham	$61,300	$49,040
Brunswick, GA MSA	Glynn	$55,300	$44,240
Brunswick, GA MSA	McIntosh	$55,300	$44,240
Hinesville-Ft. Stewart, GA HMFA	Liberty	$48,700	$38,960
Long County, GA HMFA	Long	$51,000	$40,800
Rural	Bulloch	$51,700	$41,360
Rural	Camden	$65,400	$52,320
Rural	Screven	$50,900	$40,720
Source: huduser.org and U.S. Census			

Economic Development

The Coastal Regional Commission serves as the regional planning agency for the ten counties in Coastal Georgia: Bryan County, Bulloch County, Camden County, Chatham County, Effingham County, Glynn County, Liberty County, Long County, McIntosh County, and Screven County. These counties are bound together as a region by their geography, their key manufacturing sectors, two major ports, a robust transportation network, a significant military presence, and most importantly – a regional commitment to economic development.

We have identified the following trends and issues relating to the economic characteristics of the region, including the region's *economic base*, its *labor force*, regional *economic resources*, and ongoing *economic trends* within the region.

Economic Base

Overview

Through the Coastal Regional Commission's empirical observations, the Aerospace Product and Parts Manufacturing Sector (NAICS Code 3364) is an extremely strong sector of the regional economy and one with great potential for continued growth. Quantitative data is difficult to obtain for this sector making the Location Quotient non-reportable; however, Gulfstream Aerospace alone employs 65% of the Manufacturing Sector of the Chatham County economy. Gulfstream Aerospace and Stambaugh Aviation both have a significant presence in Brunswick, GA located in Glynn County towards the southern end of the region.

Coastal Georgia has the good fortune to have a diversified economy that provides economic resilience should there be a downturn in one particular sector of the economy. We are strong in non-manufacturing sectors of the economy, particularly Tourism and Hospitality, Higher Education, and Healthcare. The film and studio production industry has just established a significant presence in Effingham County. The Georgia Ports Authority operates the Port of Savannah and the Port of Brunswick. The Port of Savannah is the second busiest port on the Eastern Seaboard and is the largest single container terminal in

North America. The Port of Brunswick is the largest automobile facility in North America. Strategically located with easy connectivity to air, ground, and rail transportation, Coastal Georgia can provide the logistics for getting goods to and from the global market; with the development of the Georgia Spaceport on the horizon in Camden County, the old saying "the sky's the limit" may no longer apply to Coastal Georgia.

Coastal Georgia understands a manufacturing economy is a strong economy. While we are strategically growing our aerospace industry and preparing for a strong tomorrow, we have solid fundamentals for today's economy. We meet or exceed the thresholds for top-third ranked location quotients in several sectors across the region; including Sugar and Confectionery, Petroleum and Coal, Cement and Concrete, and Lime and Gypsum in Chatham County, Cement and Concrete in Effingham County, and Nonmetallic Mineral Product Manufacturing in Bryan, Bulloch, Chatham, Effingham, and Liberty Counties. See Table 10 below.

Table 10
Top-Third Ranked Manufacturing Industries in Coastal Georgia

NAICS Code	NAICS Title	Jurisdiction	Location Quotient	Establishment LQ Cutoff	Difference
3113	Sugar and Confectionary	Chatham County	6.23	1.30	4.93
3241	Petroleum and Coal	Chatham County	1.83	1.32	0.51
3273	Cement and Concrete	Chatham County	1.56	1.38	0.18
3274	Lime and Gypsum	Chatham County	9.35	1.26	8.09
3273	Cement and Concrete	Effingham County	8.10	1.38	6.72
327	Nonmetallic Mineral Product Manufacturing	Bryan	2.36	n/a	n/a
327	Nonmetallic Mineral Product Manufacturing	Bulloch	4.41	n/a	n/a
327	Nonmetallic Mineral Product Manufacturing	Chatham	1.17	n/a	n/a
327	Nonmetallic Mineral Product Manufacturing	Effingham	3.64	n/a	n/a
327	Nonmetallic Mineral Product Manufacturing	Liberty	2.79	n/a	n/a

Source: Bureau of Labor Statistics

Although small businesses and family owned concerns are found throughout the manufacturing sector in Coastal Georgia, we are also home to 39 companies with 100 employees or more, three of these employ 1,000 or more, and Gulfstream Aerospace is the

clear industry leader with more than 15,000 employees, a workforce greater than the entire population of some of our rural counties. See Table 11 below.

Table 11
Major Manufacturing Employers in Coastal Georgia

Location	Employer	NAICS Code	NAICS Title	Employees
Bryan County	Daniel Defense	332994	Small arms	250
	Hobart Corporation	333241	Food product machinery	113
	Oracal USA	326113	Unlaminated plastics	128
Bulloch County	Briggs & Stratton	333618	Lawnmower engines	550
	Viracon Georgia	327211	Flat glass	402
	VF Jeanswear	315240	Women's apparel	400
Camden County	Lockheed Martin	334511	Search & nav. Equip	531
	MeadWestvaco	322130	Paperboard	234
Chatham County	Arizona Chemical	324110	Petroleum	133
	Ash Shipping	311340	Confectionery	200
	Building Materials Corp.	321219	Reconstituted wood	150
	EMD Millipore	325180	Inorganic chemicals	180
	GE Aviation	488190	Aviation support	150
	GA Dept. of Def.	488119	Airport operations	200
	Georgia Pacific	327420	Gypsum products	150
	Great Dane	336212	Truck trailer manuf.	1,000
	Gulfstream Aerospace	336411	Aircraft manufacturing	15,657
	Honeywell International	334511	Search & nav. Equip.	543
	Imperial Savannah	311314	Cane sugar refining	125
	International Paper	322121	Paper mills	637
	Lummus Corp.	333517	Machine tool manuf.	160
	Netjets International	481219	Non-sched. Air trans.	665
	Owens Corning	327993	Mineral wool	140
	Peter Brasseler	339114	Dental equipment	225
	Rocktenn	322130	Paperboard	520
	Roger Wood Foods	311612	Meat processing	250
	Standard Concrete	327390	Concrete products	100
	Talaria	336612	Boatbuilding	154
Effingham County	EFACEC Group	334111	Elec. Computer manuf.	105
	Georgia Pacific	322121	Paper mills	1,500
	Southern Sample	327120	Structural clay	134
Glynn County	Brunswick Cellulose	322110	Pulp mills	650
	Georgia Pacific	327420	Gypsum products	292
	Jered LLC	335314	Relays & Ind. Controls	100
	Rich Products Corp.	311710	Seafood product	301
Liberty County	Coca-Cola	312111	Soft drink manuf.	116
	International Greetings	322220	Paper bag products	170
Screven County	King American	313210	Broadwoven fabrics	390
	Koyo Bearings	332991	Ball and roller bearings	320

Source: Georgia Department of Economic Development

Labor Force

The following section discusses the region's labor force by county, including employment status, occupations, leading industries, personal income, wages, and commuting patterns.

Bryan County

Bryan County has 30 businesses participating in the manufacturing industries. Major employers include Daniel Defense, a small arms manufacturer (149 employees), Hobart Corporation, a manufacturer of food product machinery (113 employees), and Oracal USA a manufacturer of unlaminated plastic products (128 employees).

Bryan County has a labor force of 15,816, of these 14,880 are employed with an effective unemployment rate of 5.9% as of December 2013. There are 4,439 workers employed in industry, 2,111 employed by the major employers within the county; and the county's most significant industry by Location Quotient (LQ) is nonmetallic mineral product manufacturing with a 2.36 LQ.

Bulloch County

Bulloch County has nearly 100 businesses participating in the manufacturing industries. These include six corporations in the Nonmetallic Mineral Product Manufacturing sector, three corporations in avionics and aviation operations, and two corporations that manufacture engines or transmissions. Major employers include Briggs & Stratton (550 employees), Viracon Georgia, Inc. (402 employees), and VF Jeanswear (400 employees).

In Statesboro, the county seat of Bulloch County, Georgia Southern University has created City Campus a joint city and university facility in downtown Statesboro developed to serve as a catalyst for regional economic development. The mission of the City Campus is to increase the economic competitiveness of southeast Georgia by offering programs that lead to new businesses being formed and jobs being created.

City Campus sponsors three programs:

- The Bureau of Business Research & Economic Development (BBRED) – the economic outreach are of the College of Business Administration (COBA) at Georgia Southern conducting applied research on community and business development in Statesboro and the region of southeast Georgia;
- The Center for Entrepreneurial Learning and Leadership (CELL) – a center for entrepreneurship that "seeks to contribute to the economic and social well-being of Statesboro and surrounding counties through entrepreneurship education and venture creation;" and
- Georgia's Enterprise Network for Innovation Entrepreneurship (GENIE) – a virtual incubator linking businesses in economically challenged counties in rural Georgia to the resources available through COBA whose major goal is to create and/or retain jobs in Georgia through mentoring, connecting, and training programs.

Camden County

Camden County has nearly 50 businesses participating in the manufacturing industries. These include companies engaged in millwork, boatbuilding and repair, shipbuilding and repair, industrial machinery, construction machinery, aviation manufacturing, aviation operations, search, detection, navigation, guidance, and aeronautics manufacturing, and guided missile and space vehicle manufacturing. Major employers include Lockheed Martin (531 employees) and MeadWestvaco Corporation (234 employees). Camden County is home to the only Navy base in Georgia (NSB Kings Bay), the homeport to East Coast Trident Submarine Fleet. Camden County is actively pursuing another component of the aerospace industry by seeking an Opportunity Zone designation from the Georgia Department of Community Affairs (DCA) to develop an 11,800 acre site as the Georgia Spaceport. Successful development of this site, the influx of cutting edge technology, and the demand for a highly skilled workforce, will compliment Gulfstream's long history in the region and provide regional economic growth.

Chatham County

Chatham County has nearly 500 businesses in a very diverse manufacturing sector. Representative industries include aircraft manufacturing, air transportation support, airport operations, aviation and aeronautics, boatbuilding and repairing, candy and confectionery, cane sugar refining, cement and cement products, concrete products, dental equipment and supplies, gypsum products, industrial inorganic chemicals, machine tool manufacturing, mineral wool, nonscheduled air transportation, paper mills, paperboard mills, petroleum refineries, reconstituted wood products, sausages and other prepared meats, search and navigation equipment, and truck trailer manufacturing.

Major employers in Chatham County include Arizona Chemical Company (133 employees), Ash Shipping (200 employees), Building Materials Corporation of America (150 employees), EMD Millipore Corporation (180 employees), GE Aviation Systems (150 employees), Georgia Department of Defense (200 employees), Georgia-Pacific (150 employees), Great Dane (1,000 employees), Gulfstream Aerospace Corporation (15,657 employees), Honeywell International (543 employees), Imperial Savannah (125 employees), International Paper Company (637 employees), Lummus Corporation (160 employees), Netjets International, Inc. (665 employees), Owens Corning (140 employees), Peter Brasseler Holdings (225 employees), Rocktenn (520 employees), Roger Wood Foods, Inc. (250 employees), Standard Concrete Products (100 employees), and The Talaria Company (154 employees).

The Savannah area, located in coastal Chatham County, Georgia, boasts a flourishing economy balanced on a strong foundation that includes a thriving port, increasing tourism, a stabilizing manufacturing sector and significant military presence. We are proud of our major employers, and the numbers speak for themselves – Manufacturing Employers have a workforce of 14,406. Although the total numbers for the Aerospace Product and Parts Manufacturing Sector are not disclosed making it difficult to compute the Location Quotient for this sector of the economy, Gulfstream Aerospace alone employs 65% of the Manufacturing Sector of the Chatham County economy.

Other significant manufacturing industries for which Location Quotient data are available in Chatham County are Sugar and Confectionery (LQ 6.23), Petroleum and Coal (LQ 1.83), Basic Chemical (LQ 2.88), Cement and Concrete (LQ 1.56), and Lime and Gypsum (LQ 9.35).

We are also home to the Georgia Port Authority-Port of Savannah, the largest single container terminal in North America with over four million square feet of warehouse space, immediate access to two major interstates, 9,700 feet of contiguous berth space, a four-hour drive to major markets: Atlanta, Orlando and Charlotte, and the largest concentration of import distribution centers on the East Coast. The Savannah/Chatham metro area is the hub of an 11-county labor draw area with a population of over 700,000 and a labor pool of nearly 350,000.

Effingham County

Traditional industry is still a major presence in Effingham County with the Georgia Pacific paper mill (1,500 employees) being the largest employer; however, new technologies including aircraft parts and equipment and electronic computers are being developed. The largest manufacturing employers in Effingham County are EFACEC Group (105 employees), Georgia Pacific (1,500 employees), and Southern Sample Company (134 employees).

The Effingham County Industrial Park became the site of EFACEC Group, a Portuguese-based transformer manufacturer for their North and Central America operations. The U.S. factory is located in Rincon, GA and produces both core and shell technology power transformers. Its first plant and the only one of its kind in the U.S. EFACEC Group, one of the world's leading manufacturers of power substations, is investing $130 million in the new facility and will create up to 700 jobs.

According to research from the Georgia Department of Economic Development (GDEcD), EFACEC's Effingham County facility could generate more than 1,500 direct and indirect jobs in the region by 2017.

Glynn County

Glynn County has a diverse manufacturing base with a strong presence in aviation and related services, fresh or frozen packaged fish, paper products, and relays and industrial controls. Major manufacturing employers include Brunswick Cellulose, Inc. (650 employees), Georgia Pacific (292 employees), Jered LLC (100 employees), and Rich Products Corporation (301 employees).

Liberty County

Liberty County's top manufacturing employers include Coca-Cola (116 employees) and International Greetings USA, Inc. (170 employees).

Screven County

Screven County's two largest manufacturing employers are King American Finishing, a fabric mill with 390 employees and Koyo Bearings USA whose 320 employees produce ball and roller bearings. Screven County's economy is represented by a diverse mix of manufacturing, machining, and food processing. Equally as important as diversity is longevity of success. Many of our businesses boast record performances dating back a quarter century, some more than 50 years. Faced with the high-pressure demands of a global market Screven's long-standing industry has capitalized on new opportunities, relying on a nimble can-do workforce, supportive community leadership and great location advantages. In fact, the long-term prosperity of Screven operations is actually only natural: For today's industry, it's all about quality and speed to market, and those have always been Screven's strengths.

Economic Resources

Evaluate the development agencies, programs, tools, education, training and other economic resources available to the region's businesses and residents.

Coastal Regional Commission of Georgia

The Coastal Regional Commission facilitates a monthly council meeting with all of the cities, counties, and development authorities listed below. Each jurisdiction is represented by elected and non-elected officials and prescribed by Georgia law. In addition to the monthly council meetings, the commission's staff works in close collaboration with each jurisdiction to meet their economic development needs, to explore and develop funding opportunities, and to provide regional comprehensive planning. Beginning in July 2014, the Coastal Regional Commission will conduct regional manufacturing round tables to encourage dialogue and best practices.

Bryan County: Pembroke, Richmond Hill, and the Development Authority of Bryan County.

Bulloch County: Brooklet, Portal, Register, Statesboro, and the Development Authority of Bulloch County and Chamber of Commerce.

Camden County: Kingsland, St. Marys, Woodbine, the Chamber of Commerce, and the Joint Development Authority.

Chatham County: Bloomingdale, Garden City, Pooler, Port Wentworth, Savannah, Thunderbolt, Tybee Island, Vernonburg, the Savannah Economic Development Authority, and the Chamber of Commerce.

Effingham County: Guyton, Rincon, Springfield, and the Chamber of Commerce and Development Authority.

Glynn County: Brunswick, the County Development Authority, and the Chamber of Commerce.

Liberty County: Allenhurst, Flemington, Gumbranch, Hinesville, Midway, Riceboro, Walthourville, the Industrial Authority, and the Chamber of Commerce.

Long County: Ludowici, the County Development Authority, and the Chamber of Commerce.

McIntosh County: Darien, the County Development Authority, and the Chamber of Commerce.

Screven County: Hiltonia, Newington, Oliver, Rocky Ford, Sylvania, the Industrial Development Authority, and the Chamber of Commerce.

Higher Education: Altamaha Technical college, Armstrong Atlantic State University, Coastal College of Georgia, Georgia Southern University, Georgia Technical Aviation Program, Ogeechee Technical College, Savannah College of Art & Design, Savannah State University, and Savannah Technical College.

Economic Trends

The two projects with the greatest potential for economic impact in the region are the Savannah Harbor Expansion Project (SHEP) and the development of Spaceport Camden.

With SHEP, the Port of Savannah, operated by the Georgia Port Authority, will be able to accommodate the newer vessels being made possible by the Panama Canal expansion. These ships will be longer, have broader beams, and deeper drafts than those previously visiting the port. This will lead to an exponential increase in the tonnage arriving and departing from the port. Port expansion will create a ripple effect throughout the region in the areas of freight logistics, storage, and distribution; there will also be subsequent demands on infrastructure, including rail, highway, water, and power.

The Camden Spaceport represents a truly 21st Century realm of economic development. Although private space operations currently exist, at this point in time, private corporations must share site space and launch times with government facilities. Spaceport will be an exclusively private commercial operation and will have significant impact on the economy of Coastal Georgia and North Florida as it is developed over the next several years.

The Comprehensive Economic Development Strategy (CEDS) document submitted to EDA by the Coastal Regional Commission in 2012 identifies economic development projects throughout the region.

The following is a synopsis of information on potential projects.

Regional Projects

- Continuation of a Coastal Georgia Economic Development forum to identify and engage in projects of regional collaboration and to serve as a liaison to State legislators in Atlanta.
- Promote coordination of business retention and expansion programs for existing industries in cooperation with respective county economic development organizations and the GA Department of Economic Development.
- Identify and promote the opportunities to gain access to capital that will leverage private investments and create sustained employment.

Bryan County

- New interchange on I-95 and Belfast Keller Road and Belfast Commerce Centre Industrial Park.
- Phase II development of Interstate Centre industrial park.
- Fully developed industrial parks on I-16 and I-95.

Bulloch County

- The Development Authority of Bulloch County owns approximately 200 acres at the Interstate 16/Highway 301 interchange, most likely to be the focus of industrial development. Bulloch County is working towards master planning of the larger interchange area.
- Gateway Regional Industrial Park- Phase II of the park includes an additional 160 acres for development.

Camden County

- Development of a countywide implementation strategy addressing specific economic development actions for each city.
- Implement recommendations from the Camden County Economic Diversification study.
- Acquisition of 100 acres of land for development of a business park and installation of infrastructure with 200,000 square foot speculative building with the ability to expand.
- Infrastructure for Kingsland Commerce Park industrial site to include a water tank for fire flow.
- Design and construction of expanded rail access to connect Kingsland with CSX mainline north of Folkston in Charlton County.

Chatham County

- Improvements necessary to help locate an industry on the megasite.
- Identification and development of more industrial sites.
- Port deepening in Savannah Harbor.
- Improvements necessary to attract more aerospace and advanced manufacturing opportunities.
- Develop the Savannah region as a center for materials research and development and build on capabilities including SCAD's industrial design program and HERTY Advanced Materials Development Center.

Effingham County

- Interstate 16 Industrial Tracts: Infrastructure development (water, wastewater treatment, and road work).

Glynn County

- Additional rail capabilities.
- Existing manufacturing expansions for industries such as Georgia Pacific.

- Pad ready industrial site improvements at Tradewinds.
- The Manufacturers Round Table – once per quarter, around 30 of the areas manufacturers get together to discuss how they can pool their resources to make a positive impact on the area's business climate. As a group, they have decided to focus on working with the local education system to introduce students to modern manufacturing.

Liberty County

- Tradeport West Business Center infrastructure to include provision of road, water, sewer, drainage systems and rail improvements to service.
- Tradeport East water reclamation facility; road, water and sewer extensions; grading improvements; and an elevated water tank.
- Hinesville Technology Park: road, water, sewer extensions, and grading improvements.
- Midway Industrial Park Phase 3: road, water, sewer, drainage, and grading improvements.

Long County

- Industrial park improvements and infrastructure.

McIntosh County

- Continue to promote the McIntosh County industrial park and construct necessary infrastructure for industry expansion.
- Rail line reactivation/rail bridge/spur: Tie Ports of Savannah and Brunswick by reactivating the abandoned CSX line from Richmond Hill - Riceboro - Everett

Screven County

- Attract tenant to pad-ready site.
- Complete GRAD certification for industrial park and construct infrastructure (rail, gas, etc.) that will help attract industry.

- Acquire a rail-served site and prepare it for development.
- Assist existing industry with capital projects to facilitate expansion.

Guiding Principles: Business and Industry

The Regional Plan defines a vision to develop and facilitate the implementation of successful strategies that leverage existing regional economic engines, regional resources, state and federal government guidance and create a quality of life to attract compatible and strategic business opportunities, high wage jobs and investment to Georgia's coastal communities. Our goal is that the entire region shares in jobs and investment created through an integrated balance of sustainable economic development initiatives.

Strategies

- Promote strategic distributions of business and industry across the region consistent with natural, cultural, historic and industrial resource strategies and encourage partnerships and collaboration between economic development agencies.
- Investigate ways to share costs and benefits across jurisdictional lines for both regional marketing and project support.
- Incorporate community plans for the strategic use of land for manufacturing, distribution, etc., while recognizing and respecting natural resources and the unique differences between communities.
- Coordinate with the Georgia Ports Authority (GPA) to identify their needs and identify mechanisms for the economic development industry to strengthen the GPA and its presence in logistics, distribution, and workforce development.
- Leverage and incorporate the region's military installations (Fort Stewart Army Base, Hunter Army Airfield and Kings Bay Naval Base) and the Federal Law Enforcement Training Center to recruit economic development projects.
- Incorporate HERTY Advanced Materials Development Center's experience and position as a development center for the commercialization of materials and create incentives to retain a portion of pilot plant opportunities as new Georgia industries

and to assist development authorities in increasing recruitment win rates.

- Coordinate federal, State and local economic development funding programs and initiatives that affect the coast.
- Enhance workforce development by collaborating with business, industry, and planning of educational entities that provide necessary workforce skills.
- Increase existing industry retention and expansion rates.
- Incorporate current and future needs for housing, infrastructure, and natural resource protection into economic development initiatives.
- Encourage international economic developments that support strategic industry sectors.

Housing

Use the following factors to evaluate the adequacy and suitability of existing housing stock to serve current and future regional needs.

Housing Types & Mix

Coastal Georgia was one of the original thirteen colonies. It's not surprising to find a rich mix of housing and significant historic housing. As the region has grown, the development of housing stock over the decades has kept pace with population growth, and regionally more homes have been built in every subsequent decade than were built in the previous decade. See Table 12 below.

The single exception to that trend has been the dramatic drop in housing construction since 2010. During this short time frame, the annualized rate of home building declined between 47% and 95% among the counties and declined 85% for the region as a whole. This information clearly shows the long lasting effects of the economic decline caused by the recent recession. See Table 13.

Table 12
Age of Housing Stock

County	Total Units	Built 2010 or later	Built 2000 to 2009	Built 1990 to 1999	Built 1980 to 1989
Bryan	12,132	134	4,075	3,163	1,732
Bulloch	29,026	234	8,864	5,947	4,645
Camden	21,174	221	5,444	5,965	4,898
Chatham	120,146	1,321	25,540	16,230	17,257
Effingham	19,919	206	7,074	5,223	3,342
Glynn	40,872	152	9,795	6,983	6,554
Liberty	26,762	327	6,684	7,126	5,708
Long	5,979	239	1,517	1,847	1,159
McIntosh	9,171	52	2,294	2,649	1,387
Screven	6,706	42	778	1,204	1,174
CRC Region	**291,887**	**2,928**	**72,065**	**56,337**	**47,856**

Source: U. S. Census

Table 12 - continued Age of Housing Stock					
County	Built 1970 to 1979	Built 1960 to 1969	Built 1950 to 1959	Built 1940 to 1949	Built 1939 or earlier
Bryan	1,395	472	287	514	360
Bulloch	3,671	2,347	1,505	448	1,365
Camden	1,741	947	946	479	533
Chatham	16,734	12,493	12,305	6,422	11,844
Effingham	1,591	853	577	258	795
Glynn	6,070	4,172	3,410	1,991	1,745
Liberty	3,395	1,503	1,029	490	500
Long	569	212	216	152	68
McIntosh	1,295	590	179	347	378
Screven	1,204	702	549	313	740
CRC Region	**37,665**	**24,291**	**21,003**	**11,414**	**18,328**
Source: U. S. Census					

Table 13 Annualized Rate of Construction										
	2010+	**2000-2009**	1990-1999	1980-1989	1970-1979	1960-1969	1950-1959	1940-1949	1939 0r earlier	Decline in bldg. rate from 2000 to 2010
Bryan	45	408	316	173	140	47	29	51	36	89%
Bulloch	78	886	595	465	367	235	151	45	137	91%
Camden	74	544	597	490	174	95	95	48	53	86%
Chatham	440	2554	1623	1726	1673	1249	1231	642	1184	83%
Effingham	69	707	522	334	159	85	58	26	80	90%
Glynn	51	980	698	655	607	417	341	199	175	95%
Liberty	109	668	713	571	340	150	103	49	50	84%
Long	80	152	185	116	57	21	22	15	7	47%
McIntosh	17	229	265	139	130	59	18	35	38	92%
Screven	14	78	120	117	120	70	55	31	74	82%
CRC Region	**976**	**7207**	**5634**	**4786**	**3767**	**2429**	**2100**	**1141**	**1833**	**86%**
Source: U. S. Census and CRC										

Condition and Occupancy

Housing tenure is the term used to describe whether home occupants are renters or homeowners. It has been federal public policy for more than a decade to increase the rate of home ownership. It is felt that home ownership creates community stability, and importantly, allows home owners to build up equity in their homes and pass this equity along to subsequent generations. The creation of generational equity provides capital for future generations to afford homes of their own, and it also allows them to higher education. From a public policy perspective, this creates a more stable middle class, and more ready workforce, and stable communities.

The rate of homeownership in Coastal Georgia ranges from a low of 51% in Bulloch County to a high of 82% in McIntosh County. This compares to a statewide rate of 65.1% and a national rate of 64.9%.

Table 14
Housing Tenure

County	Occupied Housing Units	Owner Occupied	Percent	Renter Occupied	Percent
Bryan	11,230	7,880	70%	3,350	30%
Bulloch	25,254	12,852	51%	12,402	49%
Camden	18,386	11,594	63%	6,792	37%
Chatham	102,484	58,886	57%	43,598	43%
Effingham	17,830	13,666	77%	4,164	23%
Glynn	31,457	19,530	62%	12,017	38%
Liberty	23,046	11,773	51%	11,273	49%
Long	4,841	3,009	62%	1,832	38%
McIntosh	4,993	4,071	82%	922	18%
Screven	5,165	3,656	71%	1,509	29%
CRC Region	**244,686**	**146,917**	**60%**	**97,859**	**40%**
Georgia			**65.1**		**34.9**
United States			**64.9**		**35.1**

Source: U.S. Census

Another data set that we report on, that was included in our discussion of *resilient communities*, is the percentage of mobile homes, by county. As can be seen in Table 15 below, the highest percentage of families living in mobile homes is Long County at 49.2% and the lowest percentage is Chatham County at 4.6%.

Table 15 Percentage Living in Mobile Homes	
County	Percent Mobile Home
Bryan	13.90%
Bulloch	18.30%
Camden	14.20%
Chatham	4.60%
Effingham	24.00%
Glynn	12.70%
Liberty	18.50%
Long	49.20%
McIntosh	39.60%
Screven	34.00%
Source: U. S. Census	

One of the many things that the U. S. Census gathers data on is the condition of housing. The government defines substandard housing as housing units that lack one or more of the following items: complete plumbing facilities, complete kitchen facilities, no telephone service available, and overcrowding, defined as 1.5 or more persons per room. Since it is quite possible that a housing unit may have one or more of these conditions, but perhaps not all of these conditions, it is difficult to get an accurate total of the number of substandard units. The totals reflected below in Table 16 probably skew towards the high side, but it is still a valid indicator of housing needs in the community.

Table 16 Substandard Units							
County	Total Units	Lacking complete plumbing facilities	Lacking complete kitchen facilities	No telephone service available	1.5 or more persons per room	Total Substandard Units	Percent Substandard Units
Bryan	13,132	90	70	275	20	455	3.5%
Bulloch	25,254	90	147	907	215	1,359	5.4%
Camden	18,386	123	157	474	76	830	4.5%
Chatham	102,484	279	499	2,226	339	3,343	3.3%
Effingham	17,830	53	111	283	112	559	3.1%
Glynn	31,547	388	384	1,047	156	1,975	6.3%
Liberty	23,046	51	9	359	69	488	2.1%
Long	4,841	21	5	134	26	186	3.8%
McIntosh	4,993	67	47	245	0	359	7.2%
Screven	5,165	12	87	189	0	288	5.6%
CRC Region	**246,678**	**1,174**	**1,516**	**6,139**	**1,013**	**9,842**	**4.0%**
Source: U. S. Census							

Cost of Housing

The cost of housing in the region, both for owners and renters, in terms of affordability is evaluated based upon the percentage of gross family income that must be set aside for housing. For home owners, housing cost is the sum of principal, interest, taxes, and insurance (PITA). For renters, housing cost is the sum of rent paid plus utilities.

Cost-Burdened Households

Evaluate the needs of households that are cost-burdened (paying 30% or more of net income on total housing costs) and severely cost-burdened (paying 50% or more of net income on total housing costs). Also evaluate the relationship of local housing costs and availability to the socioeconomic characteristics of these households, including income, income from social security or public assistance, employment status, occupation, household type, age of householder, household size, race, and unit type.

Table 17.1 Housing Cost Burden – Owner-Occupied Housing Units with a Mortgage					
County	Housing Units with a mortgage	Monthly Costs 30.0-34.9%	Percent	Monthly Costs 35%+	Percent
Bryan	5,843	679	12%	1,123	19%
Bulloch	7,799	694	9%	1,705	22%
Camden	7,892	727	9%	2,336	30%
Chatham	38,791	2,892	7%	12,008	31%
Effingham	9,692	788	8%	1,918	20%
Glynn	12,147	783	6%	3,581	29%
Liberty	8,376	703	8%	2,351	28%
Long	1,934	149	8%	476	25%
McIntosh	2,037	115	6%	772	38%
Screven	1,812	133	7%	502	28%
CRC Region	**96,323**	**7,663**	**8%**	**26,772**	**28%**
Source: U. S. Census					

Table 17.2 Housing Cost Burden – Owner-Occupied Housing Units without a Mortgage					
County	Housing Units without a mortgage	Monthly Costs 30.0-34.9%	Percent	Monthly Costs 35%+	Percent
Bryan	2,026	8	0.4%	284	14%
Bulloch	4,847	207	4.3%	382	8%
Camden	3,568	90	2.5%	467	13%
Chatham	19,470	529	2.7%	2,426	12%
Effingham	3,886	50	1.3%	274	7%
Glynn	7,259	195	2.7%	756	10%
Liberty	3,248	114	3.5%	360	11%
Long	1,053	0	0.0%	79	8%
McIntosh	2,034	55	2.7%	243	12%
Screven	1,804	55	3.0%	203	11%
CRC Region	**49,195**	**1,303**	**2.6%**	**5,474**	**11%**
Source: U. S. Census					

Table 17.3 Housing Cost Burden – Renter-Occupied Housing Units					
County	Housing Units paying rent	Gross Rent 30.0-34.9%	Percent	Gross Rent 35%+	Percent
Bryan	2,971	358	12%	978	33%
Bulloch	11,107	793	7%	5,724	52%
Camden	6,354	635	10%	2,356	37%
Chatham	39,968	3,901	10%	18,867	47%
Effingham	3,775	372	10%	1,326	35%
Glynn	11,180	926	8%	4,963	44%
Liberty	10,253	1,080	11%	4,102	40%
Long	1,717	80	5%	679	40%
McIntosh	725	31	4%	315	43%
Screven	1,082	81	7%	498	46%
CRC Region	**89,132**	**8,257**	**9%**	**39,808**	**45%**
Source: U. S. Census					

Special Housing Needs

Evaluate special housing needs in the region (e.g., housing needs of residents who are elderly; homeless; victims of domestic violence; migrant farm workers; persons with mental, physical, or developmental disabilities; persons with HIV/AIDS; and persons recovering from substance abuse) using information obtained from local service providers on caseloads, waiting lists, etc.

Jobs-Housing Balance

Evaluate housing costs compared to wages and household incomes of the resident and nonresident workforce to determine whether sufficient affordable housing is available and appropriately distributed within the region to allow people to live near where they work. Data on the commuting patterns of the resident and nonresident workforce may assist in determining whether there is a jobs-housing balance issue in the region. Also evaluate any barriers that may prevent a significant proportion of the region's nonresident workforce from residing in the jurisdiction, such as a lack of suitable or affordable housing, suitably zoned land, etc.

Community Facilities and Services

Evaluate the following major public facilities and services. Evaluate the adequacy and useful life of these facilities and services for meeting future needs of the region and how to make the most efficient use of existing infrastructure to accommodate future development in the region. Also evaluate how service areas or levels of service are likely to influence future development patterns or impact natural or cultural resources, and identify how these facilities may be used to appropriately direct development patterns of the region.

Water Supply and Treatment

Identify both distribution and treatment systems, whether publicly or privately operated;

Sewerage System and Wastewater Treatment

Identify both collection and treatment systems, whether publicly or privately operated. Also evaluate the use of onsite septic systems within the region, especially where their widespread use may have adverse environmental impacts; and

Other Facilities and Services

Identify fire protection, public safety, parks and recreation, stormwater management, and solid waste management facilities.

Intergovernmental Coordination

Evaluate the adequacy, opportunities, suitability, and need for coordination mechanisms and processes in the region considering:

All local governments within the region;
Independent special authorities and districts, such as water and sewer authorities and districts;
School boards;
Independent development authorities and districts, such as industrial or downtown development authorities; and
Any federal, state, or regional programs and activities that relate to local planning, such as the Coastal Management Program, the Appalachian Regional Commission's Program, strategies for air-quality non-attainment areas, sub-state regional water supply and/or water quality protection plans, greenspace programs, and regional transportation plans.

Transportation System

Map the service areas and/or levels of services for the following major components of the local transportation system. Evaluate the adequacy these components for serving needs of the region throughout the planning period.

Road Network

Identify roads, highways and bridges. Also identify any significant issues with the road network, including connectivity, signalized intersections or inadequate signage.

Alternative Modes

Identify bicycle, pedestrian facilities and public transportation or other services for populations without automobiles. Also identify areas of the region where mode choice is limited. Evaluate how effectively mobility needs of the region are met by these alternative transportation modes.

Railroads, Trucking, Port Facilities and Airports

Identify freight and passenger rail lines, major rail intermodal facilities, non-rail freight operations, seaports, harbors, and commercial and general purpose air terminals. Evaluate the impact of these on the overall transportation network.

Transportation and Land Use Connection

Identify areas of the region experiencing significant traffic congestion or having significantly underutilized transportation facilities. Evaluate the role of land use (e.g., scale of development, inefficient development patterns) in this mismatch of facility capacity and demand.